SPRING 2010 ISSUE 13 **INDOOR CLIMATE** 10 EURO

DAYLIGHT & ARCHITECTURE
MAGAZINE BY VELUX

RACHEL WHITEREAD "HOUSE". PHOTO BY © JOHN DAVIES 1993

E

VELUX EDITORIAL

CHANGE THE INDOOR CLIMATE!

"There is no point in saving energy, if it jeopardises the indoor climate," says Bjarne Olesen, head of International Centre for Indoor Environment and Energy at the Technical University of Denmark (DTU). The discussion on energy often leaves out the fact that energy consumption in buildings is used to meet human needs; to keep us warm and cosy in winter, cool and shaded in summer, serviced with electrical equipment and happy and healthy all year round.

A good indoor climate, with generous daylight levels and adequate ventilation, is the key to making offices, schools and homes healthy. Yet there is great potential for improving the indoor climate in the world's buildings: in the EU today, we spend 90 % of our time indoors. But up to 30% of the buildings neither contribute to nor provide a healthy indoor climate.

Can we do better, then? Can we design buildings that protect the global climate without compromising a healthy indoor climate? With our products and the way they are used, the VELUX Group wishes to encourage and contribute to more sustainable ways of creating buildings. We call it Sustainable Living - and call for a holistic view. We believe that buildings need to be designed for meeting basic human needs for health, well-being and comfort with maximum daylight and fresh air, and there must be specific focus on energy efficiency and sustainable energy sources.

In this issue of D&A we seek to compile historic, scientific and human-based approaches as well as the architect's and engineer's points of view on indoor climate. Alan Powers, Philomena Bluyssen and Fred Pearce explore the history of indoor climate and recent scientific findings about what makes a good indoor climate. Anthropologist Bettina Hauge provides us with new research on how important fresh air is to people in their homes. We also give an account of what the Simonsen family experienced in their new home, Home for Life. The building is the first in the VELUX Model Home 2020 project and currently functions as a living experiment for a different approach to indoor climate. A scientific angle on the topic is the reportage from the International Centre for Indoor Environment and Energy at DTU, where an international and interdisciplinary team of researchers is exploring what will make our buildings and indoor spaces more healthy and comfortable in the future.

Finally, we present an interview with American architect and artist James Carpenter, who brings daylight into its essential role as the force that reveals architecture. Carpenter was awarded the Building Component Award by the VILLUM and VELUX Foundations for his work on daylight and its essential means to improving the quality of interior and urban spaces and thus improving the quality of life of human beings.

D&A cannot offer an all-encompassing formula to better indoor climate. Yet certain key aspects reappear: daylight and natural ventilation – applied in a sufficient measure – can boost the health and well-being of people. That both are closely linked to windows is not a coincidence. Windows must be opened, they must provide a view, control fresh air and daylight, and be the important information and perception link to nature – as they have been ever since they were invented.

Enjoy the read!

SPRING 2010
ISSUE 13
CONTENTS

NOW 4

Architecture as climate design: R&Sie erects a witch's cottage overgrown by ferns in Paris, Francisco Mangado builds a light-filled swimming pool in Ourense. Peter Zumthor receives the Daylight Award of the Swiss VELUX Stiftung for his thermal bath in Vals. Also: Arabian bathing culture in Andalusia, brought to light by architect Francisco Ibáñez.

REFLECTIONS 48
THE ARCHITECTURE OF THE POST-STUPID ENVIRONMENT

The history of indoor climate in architecture is largely unexplored. On behalf of Daylight&Architecture, Alan Powers now portrays the most important lines of development for the first time: from mostly passive mechanisms of climate regulation in traditional architecture to the increasing 'technisisation' of modernity – and back again.

DAYLIGHTING DETAILS 54
THE INDOOR CLIMATE CHANGE

In well-insulated new buildings with air-tight exterior surfaces, there is a particular danger of the indoor climate suffering as a result. How this can be avoided and what role psychology plays in the perception of climate is being researched by the Centre for Indoor Environment and Energy of the Danish Technical University (DTU). Christian Bundegaard visited the former workplace of Ole Fanger on behalf of Daylight&Architecture.

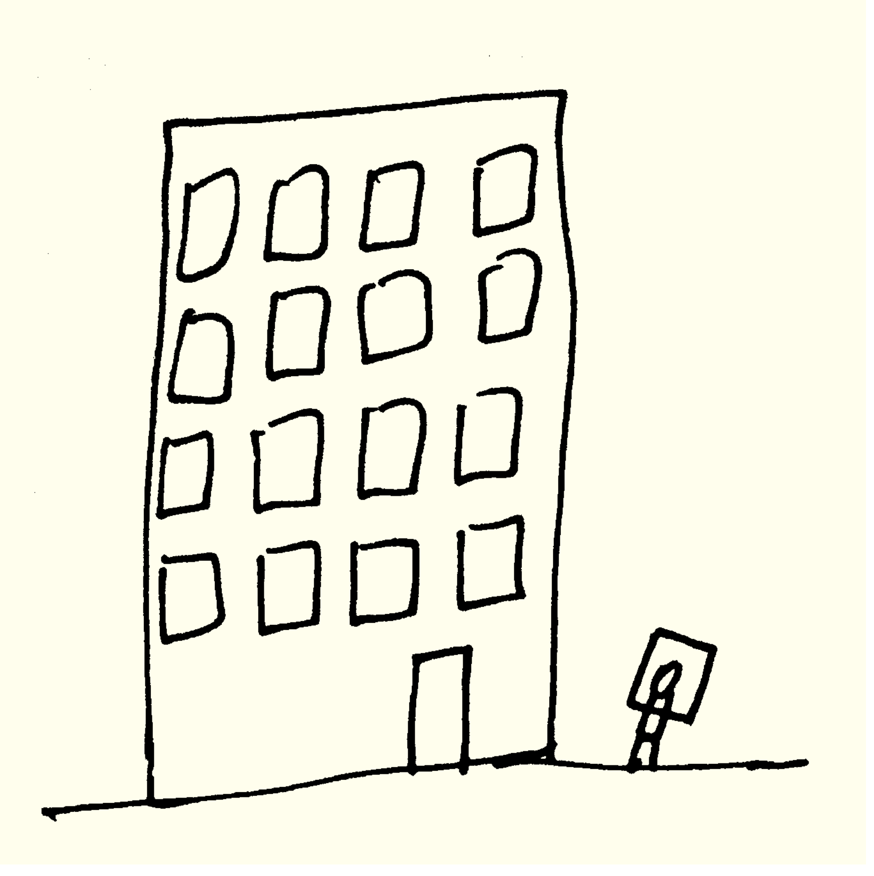
VELUX INSIGHT 68
THE HOUSE THAT GIVES MORE THAN IT TAKES

Can CO_2 neutrality and a healthy indoor climate be combined in a building? The experimental house called Home for Life in Lystrup near Århus is intended to answer this question. It is being occupied by a family of four for an entire year. Read how things are going so far.

VELUX PANORAMA 78

Multiple strategies and two objectives: health and well-being. How future buildings can provide their users with an optimum living, learning and working climate is illustrated by a mountain hotel in Norway, an engineer's office in the Netherlands and a university building in Denmark.

MANKIND AND ARCHITECTURE 8
UNDERSTANDING THE INDOOR ENVIRONMENT/ A BREATH OF FRESH AIR



PART ONE
For a long time now, researchers and engineers have been creating systems for regulating temperature, humidity and the quality of indoor air. Health problems indoors, however, continue to exist. In her article, Philomena Bluyssen discusses why indoor climate is more than the sum of its parts – and what a highly promising alternative could look like.

PART TWO
As proven by research results again and again, daylight and fresh air are essential for people's health and well-being. Fred Pearce has created a compilation of the most important such results and, in his article, asks what the effects of this knowledge are for future indoor-climate planning.

DAYLIGHTING 30
AIRING OUT AT HOME: A SENSORY EXPERIENCE AND SOCIAL RITUAL

The behaviour of people in terms of ventilation is determined by rituals and habits as well as by sensory perception and social factors. The Danish anthropologist Bettina Hauge has carried out a detailed examination for VELUX of these 'fresh-air rituals' of her fellow human beings.

NOW

The things that make architecture tick: projects, events and selected new developments from the world of daylighting.

REDISCOVERED BEAUTY

Baza is around 100 kilometres to the north east of Granada and during the Middle Ages was under Arabian rule, as was the whole of Andalusia. The Arabian baths of Baza also come from the time of the Almohad rule in the 13th century. The fact that they would once again be one of the main sightseeing attractions in this town of 20,000 inhabitants was completely unforeseeable just a few years ago. Over the centuries, the surrounding earth had risen by almost three metres. A house had been built above the baths themselves and two of the brick vaults had been destroyed in the process. The neighbouring entrance courtyard in the north had disappeared behind a temporary-looking, unplastered concrete wall.

Before Francisco Ibáñez and his office could begin reconstruction and development of the site for tourism, archaeologists and demolition companies had to carry out some initial work. Ibáñez arranged for a protective construction made of fair-faced concrete to be built above the baths and the patio. A large revolving door, panelled with metal Corten steel strips, marks the entrance. Otherwise, the building is completely enclosed except for two "peepholes". From the entrance level at the height of the old barrel vault, the visitor has to go down a staircase to reach the historical entrance courtyard. Ibáñez Arquitectos only had the most important constructional and spatial elements of the baths restored, above all the two destroyed vaults that were re-walled using the historical brick technique on wooden soffit scaffolding. Floors were added in accordance with original findings. Glass panels that can be walked on cover those parts of the former baths that have been retained until today. However, the elements that are probably most important for the spatial impression are the numerous small skylights that create the "stars-in-the-sky effect" so typical of Arabian baths. In order to allow them to attain their full effect, the architects inserted eight glass roof openings into the reinforced concrete superstructure. They are inclined at different angles in different directions so that – at least when the sunlight hits them directly – hardly any two of them produce the same light effect. The position and alignment of the roof openings were determined with the help of a simulation program on a computer. The aim was to direct as much direct sunlight as possible through the skylights of the old brick vault and as little as possible onto the fair-faced concrete walls of the new building.

PHOTO: FERNANDO ALDA

FLOATING BALCONY WITH A VIEW

Immersed in water and in soft, indirect light, swimmers enjoy the water in the new university baths of Ourense in northern Spain. The building created by Francisco Mangado is located at the point where a residential area and the campus of Vigo University touch each other. This location and the views it allows were the characterising factors on which the design is directly based. According to the architects, they influenced "everything, from structure to layout and envelope".

The building rests on an imposing ground floor made of concrete and panelled in natural stone and therefore rises high above the surrounding terrain. Above ground, it contains the swimming pool and the associated building equipment. At the front ends of the pool, it ends in two eight-metre-long projections. Like the main floor as a whole, they are glazed on three sides. The fourth facade is completely closed, except for a single, large window.

Inside the swimming hall, all eyes are attracted to the ceiling, in spite of the generous glazing. The reason is that Mangado put a great deal of care and effort into the design of this surface, which is the largest in the building. The swimming hall has a T-beam ceiling made of reinforced concrete. Its joists 'disappear' behind regularly folded ceiling panelling made of wood painted white. Interacting with the white floor tiles and swimming pool, it reflects the light coming from the side deep into the interior of the hall. Additional light from above comes through skylights integrated in the folds. The inner sides of these skylights are panelled with plaster board. Form and daylight lend structure to the room, endow it with different atmospheres and directions. In the inner area where the swimming hall is highest, there is the least amount of light. Here, everything concentrates on swimming. In contrast, the ceiling dips towards the facades, as a result of which there is a field of tension between the room's shape, which is directed inwards, the daylight coming in from the side and the view over the university campus of Ourense.

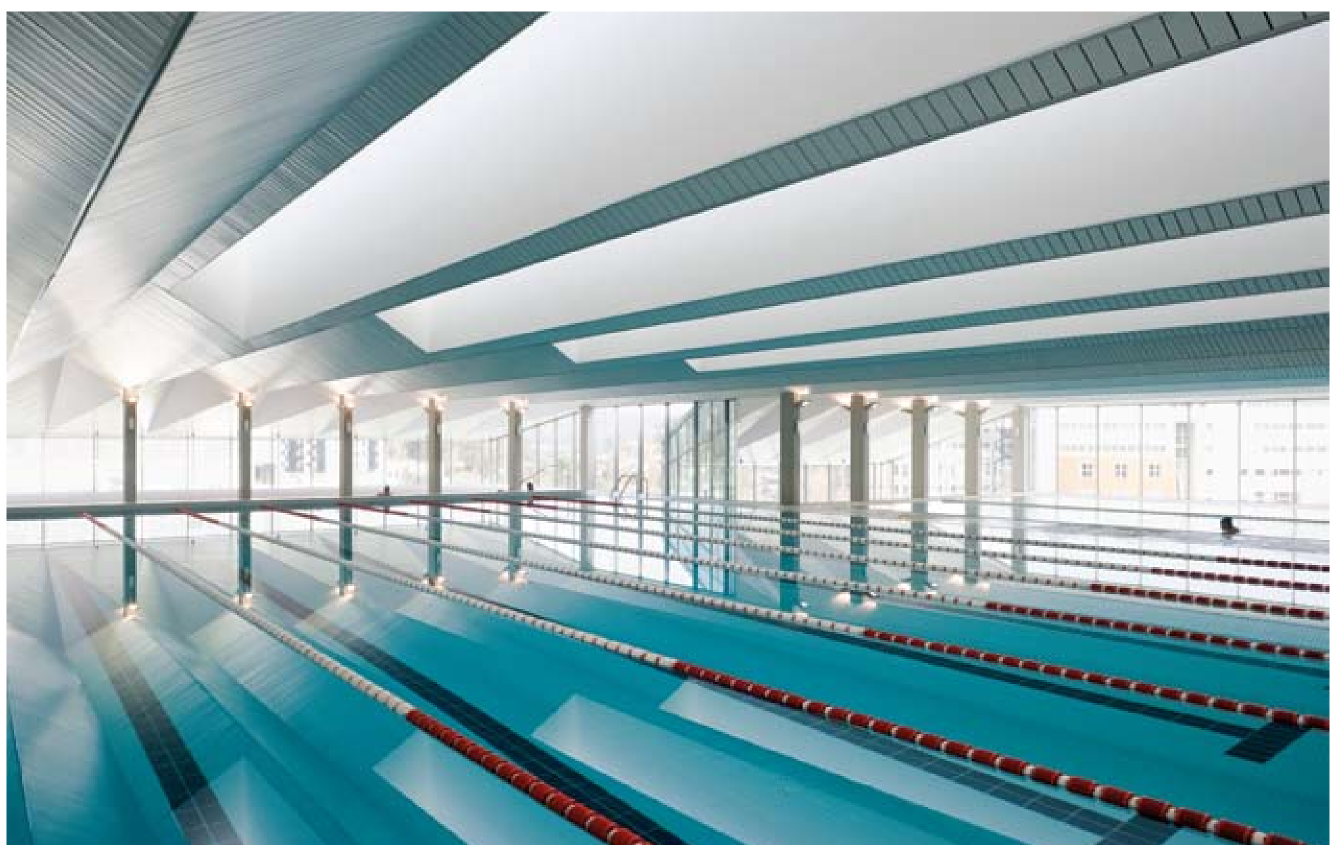


PHOTO: PEDRO PEGENAUTE

PHOTO: VELUX STIFTUNG

PHOTO: R&SIE

DAYLIGHT AWARD GOES TO PETER ZUMTHOR

The Swiss VELUX Stiftung, together with the 'ETH Wohnforum' (housing forum) of the Eidgenössische Technische Hochschule (ETH) in Zurich, called the Daylight Award into being in 2007. The prize is given for innovations in the use of daylight in architecture and has remained the largest architectural prize in Switzerland.

In January 2010, the Daylight Award was conferred for the second time. Worth 100,000 Swiss francs, the main prize in 2010 went to a building that already belongs to the 'classics' of contemporary architecture: the spa in Vals by Peter Zumthor. In the view of the jury, the spa building is an outstanding example of what can be done with daylight in architecture: "The building is exceptional, already a 'classic'. It is still perceived as the most accomplished project in terms of daylight due to an archaic, minimalistic layout and an outstanding interplay with light and darkness."

James Turrell can also be regarded as just such an artist. His project entitled 'Skyspace Piz Uter' was one of two that received special recognition. The other one was the 'Kunst(Zeug)Haus' in Rapperswil which was converted into a museum, a project of architects Isa Stürm and Urs Wolf from Zurich.

This year, an honorary prize worth 20,000 Swiss francs from the committee of the VELUX Stiftung was also awarded for the first time. The foundation awarded it to biochemist and neuro-scientist Anna Wirz-Justice, who had campaigned for a better understanding of the effect of daylight on people and health and for the use of daylight as a therapy for mental illnesses.

Neutral experts from the media, colleges and universities, research and associations nominated 64 objects for this year's Daylight Award. 48 of these buildings were finally submitted by their architects for the competition. In November 2009, an independent jury assessed the submitted projects. Its members were Prof. Colin Fournier (architect, Bartlett School of Architecture, London), Bob Gysin (architect, winner of the Daylight Award 2007), Prof. Dr. Anna Wirz-Justice (Centre for Chronobiology, University of Basel), Prof. Dr. Jean-Louis Scartezzini (Chairman of ICARE, EPFL, Lausanne), Roland Stulz (architect, head of Novatlantis, ETH Zurich), Kurt Stutz (VELUX foundation) and Bodil Wälli (VELUX foundation).

URBAN WITCH'S COTTAGE

For many years now, French architects François Roche and Stéphanie Lavaux (R&Sie) have been investigating the potential common features of architecture and living organisms. Tent-like structures, which gradually become overgrown with vegetation, are a trademark of R&Sie. In extreme cases, the intention is to make the architecture an inseparable and interwoven part of its environment to such an extent that later generations will need aids such as GPS in order to find out where it actually is.

In their 'I'm lost in Paris' project as well, R&Sie remain true to this approach. The name says it all. Already, the 130 square metre building in an interior courtyards of the 3rd arrondissement can no longer be recognised for what it is. The basic construction is comparatively conventional. It is a two-storey building made of solid reinforced concrete, insulated with PU spray foam and then enclosed in geo-textiles. The actual skin of the building consists of around 1,200 ferns in a woven wire mesh attached to the facades and roof of the building. The roots of the plants are not in the ground but in small wire-mesh baskets and are supplied with a nourishing solution by means of a hose system. In front of the windows, 300 mouth-blown glass beakers were suspended in the woven wire construction whereby their light reflections create fascinating effects in the interior of the building. R&Sie compare their new building to a 'witch's cottage'. This is because of the chemical processes that take place inside and on the outside of the house. The rainwater falling on the roof is collected, routed into the cellar, enriched with nutrients and then pumped to the plants via hoses. Eight separate water circuits supply different parts of the building's envelope. This means that the amount of solution being supplied can be individually adjusted to the level of sunshine reaching the respective part of the facade and therefore to the actual amount of water needed by the plants. The fertiliser for the plants is also created on the house. This is done by the glass beakers, in which the occupants cultivate colonies of rhizobium nodule bacteria. The characteristics of such bacteria enable them to bind molecular nitrogen – the most important nutrient for all cultivated plants.

Mankind as the focal point of architecture: interior views of a corresponding relationship.

UNDERSTANDING THE INDOOR ENVIRONMENT PUTTING PEOPLE FIRST

By Philomena M. Bluyssen
Illustrations by Dan Perjovschi

How to achieve a healthy indoor environment has been an issue among architects, engineers and scientists for centuries. For most of this time, however, science has relied on the optimisation of single factors such as thermal comfort or air quality. The realisation that the indoor environment is more than the sum of its parts, and that its assessment has to start from human beings rather than benchmarks, has only been gaining ground in recent years.

THE IMPORTANCE of the indoor environment, and of indoor air quality in particular, was recognised as early as the first century BC, as described by Vitruvius in his ten books of architecture[1]. However, it was not until the early decades of the twentieth century that the first relations between parameters describing heat, lighting and sound in buildings and human needs were established. In fact, the last hundred years have seen much effort put into management of the indoor environment with the goal of creating healthy and comfortable conditions for the people living, working and recreating in them for more than 90% of their time. Nevertheless, enough health problems and comfort complaints still occur to trigger more research and development.

HISTORY

Although chemistry only emerged as a separate science during the 17th century, from the Middle Ages onwards people began to realise that air in a building should be good and – and if it were not, the result could be diseases or at least extreme discomfort because of bad smells. Until the beginning of the 19th century, the miasmatic theory of disease (which has now been replaced by the germ theory of disease, with micro-organisms seen as the cause of many diseases), was used to explain the spread of diseases such as cholera[2]. Miasma (Greek for pollution) was considered to be a poisonous, smelly vapour or mist filled with particles from decomposed matter (miasmata) that could cause illnesses. Ventilation thus became an important part of the indoor environment. Discussions on how much ventilation was sufficient to prevent noxious odours and the spread of disease had already begun and are still taking place today[3]. It is not an easy problem to solve.

In the late 19th century, the environmental factor 'thermal comfort' was introduced as being part of the overall concept of indoor comfort. It was recognised that poorly ventilated rooms, besides being responsible for bad air quality, could also result in unwanted thermal effects, both through temperature and humidity[4, 5].

The positive health effect of light, in this case of sunlight, was acknowledged by the Egyptians, ancient Greeks and Romans, each of whom worshipped their own sun god. Much later, at the beginning of the 1900s, sunlight as a healer was put to practical use. Sanatoria were built for light therapy for people suffering from skin diseases, among other ailments. The late 1980s saw light therapy being used for the first time to cure winter depressions (Seasonal Affective Disorder – SAD) with artificial light. Artificial lighting has been an applied science since around the 1890s and early 1900s when the development of the first electrical lamps made it possible to extend the working day well into the dark hours[6].

Considering another aspect of our environment, the ancient Greeks and Romans realised that good hearing conditions were important for an audience listening to speech or music, whether indoors or outdoors. They placed audiences on steep curved hillsides to reduce distance and focus the sound. Not all noise is welcome though; like bad air it can be something we would rather do without. Noise or unwanted auditory experience became an important aspect of practical acoustics in the 1970s. It was considered as a form of environmental pollution and noise control developed into a major branch of acoustical engineering.

In summary, the indoor environment as such can be described by the following so-called environmental factors or (external) stressors:

- Indoor air quality: an umbrella term comprising odour, indoor air pollution, fresh air supply, etc.
- Thermal comfort: dependent on moisture (humidity), air velocity, temperature, etc.
- Acoustical quality: noise from outside, indoors, vibrations, etc.
- Visual or lighting quality: view, illuminance, luminance ratios, reflection, etc.

These factors have slowly become incorporated into the building process through environmental design. Around 1900, new discoveries in the science of physics and chemistry with respect to electricity, light, sound and airborne substances made it possible to improve many of the indoor environmental aspects, such as artificial lighting, heating and cooling. On the other hand, new technologies also introduced health and comfort problems that had never been encountered before. Among these are legionnaires' disease and later, with the introduction of new materials, formaldehyde, and ultimately, in the 1980s, the so-called SBS (Sick Building Syndrome) symptoms.

DISORDERS AND DISEASES

The human senses, the "windows of the soul"[7], are basically the instruments we have to report or indicate whether we feel comfortable in the indoor environment and how we feel our health is affected by it. We judge the indoor environment by its acceptability with respect to heat, cold, smell, noise, darkness, flickering light and other factors. But in terms of health effects, it is not just the human senses that are involved but the whole body and its systems. Indoor environmental (external) stressors that can cause discomfort and health effects comprise both environmental and psycho-social factors, such as working and personal relationships. Moreover, factors such as sex, smoking, genetics and age play a role.

Environmental stimuli caused by the environmental parameters provide the input for our bodily sensations. The three major regulation and control systems of the human body (the nervous system, the immune system and the endocrine system) trigger both mental (memories, anxiety, etc.) and physical (fight or flight, protection, symptoms etc.) responses[8]. Depending on internal stress factors such as the declining performance of the senses and the immune system with age,, but also genetic defects (such as colour blindness) and psycho-social aspects (context, personal experience), our bodily responses, consciously or unconsciously, can differ in quality, quantity and over time. Table 1 provides an overview of the possible diseases and disorders related to the different parts of the human body involved in responding to indoor environmental stress factors. Psychological or mental effects are not included in this overview because they are difficult to pin-point. Not being able to cope with a certain situation, consciously or unconsciously, can cause a whole range of different diseases and disorders that are mostly indirectly related to environmental factors and affected by psycho-social and personal factors[9].

In fact, together with the systemic effects, they form a category of their own, influenced by and influencing all these regulation and control systems.

INDOOR ENVIRONMENTAL CONTROL

Over the years, control of indoor environmental factors has focused merely on the prevention or cure of their observed physical effects in a largely isolated way – i.e. trying to find separate solutions for thermal comfort, lighting quality, sound quality and air quality with models that in general consider only physical conditions and address only one parameter at a time. Many control strategies for these parameters have been implemented in order to minimise or prevent possible diseases and disorders of the human body and its components (see Table 2). Only in the last decades of the 20th century was an attempt made through epidemiological studies to approach the indoor environment in a holistic way. The scientific approach towards evaluating and creating a healthy and comfortable indoor environment developed from a component-related to a bottom-up holistic approach that tried simply to add the different components[11]. Performance concepts and indicators emerged, including not only environmental parameters but also possible associated variables such as characteristics of buildings. New methods of investigating indoor environmental quality from different perspectives were introduced[12]. Nevertheless, control strategies were still focused on a component basis. Even though these control strategies are currently being applied, complaints and symptoms related to the indoor environment still occur.

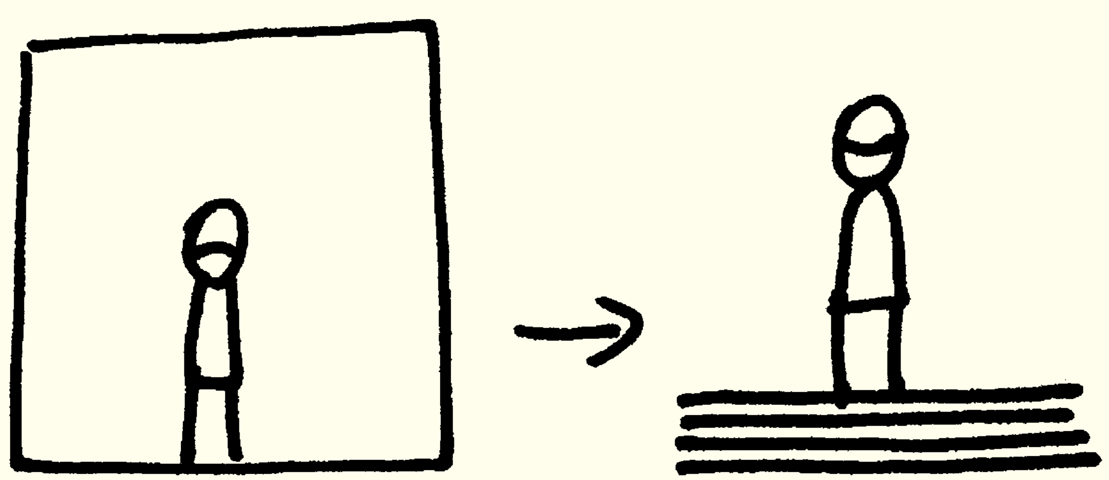
Table 1
Diseases and disorders related to the human body caused by indoor environmental stress factors[10]

Level	**Skin**	**Eyes**	**Ears**	**Nose**	**Respiratory tract**
Discomfort	Warm, cold, sweat, draught	Too much light, too little light, blinding, glare, reflections	Disturbance, hearing and understanding problems	Smell, irritation	Cough, shortness of breath
Systemic effects		Tiredness	Tiredness		Chest pain, wheezing
Allergic or irritant reaction	Contact dermatitis, dry, itchy, red skin	Redness, itching, dry feeling		Blocked or runny nose, sneezing	Asthma, bronchitis, hypersensitivity reactions
Infectious diseases	Infection (bacterial, viral or fungal)	Rare: dry eyes syndrome	Inflammation of the inner ear	Blocked or runny nose, temporary loss of smell.	Infection (bacterial, viral or fungal) e.g. bronchitis
Toxic chronic effects	Radiation- related disorders (such as sunburn)	Damage to the eye by UV light, cataract formation (as a result of long-term exposure to infrared light)	Severe and permanent loss of hearing	Permanent loss of smell	Damage and/ or tumours

Table 2
Indoor environmental factors, parameters, control and issues of concern[10]

	Thermal comfort	**Lighting quality**	**Acoustical quality**	**Air quality**
Parameters	Temperature (air and radiant) relative humidity, air velocity, turbulence intensity, activity and clothing	Luminance and illuminance, reflectance(s), colour temperature and colour index, view and daylight frequencies Sound level(s),	frequencies, duration, absorption characteristics, sound insulation. reverberation time Pollution sources and air concentrations,	types of pollutants (allergic, irritational, carcinogenic, etc.), ventilation rate and efficiency
Control	Heating, cooling and air conditioning systems. building design (insulation, facade, etc.)	Luminance distribution, integration of artificial and natural lighting, daylight influx	Acoustical control, passive noise control, active noise control	Source control, ventilation systems, maintenance, air cleaning, activity control
Issues	Dynamic effects, adaptation, integration systems with building (facade, floor and ceiling), energy use	Daylight influx, relation between thermal comfort and energy use, health effects and control	Long-term health effects, vibrations, degree of annoyance	Interpretation and detection, secondary pollution (indoor chemistry and micro-organism), (fine) dust, energy use

We judge the indoor environment by its acceptability with respect to heat, cold, smell, noise, darkness, flickering light and other factors. But in terms of health effects, it is not just the human senses that are involved but the whole body and its systems.



Current standards and guidelines have been, and are still being, developed with the traditional 'bottom-up' approach[11]. When focusing on defining threshold values for indoor environmental parameters, different subsequent steps are taken:

Step 1: Identify sources and other influencing factors
Step 2: Define dose-effect relationships
Step 3: Establish threshold values for recognised dangerous stimuli
Step 4: Assimilate or integrate all factors into end-user satisfaction.

With the exception of health-threatening stimuli, the complexity and number of indoor environmental parameters as well as lack of knowledge make a performance assessment using only threshold levels for single parameters difficult and even meaningless. Most standards are based on averaged data and do not take into account the fact that buildings, individuals and their activities may differ widely and change continuously; not every person receives, perceives and responds in the same way. This is due to physical, physiological and psychological differences but also to differences in personal experience, context and situation. Considering both the numerous indoor stimuli and the lack of a solid scientific basis, it appears implausible to make the final and complex integrating step.

TOP-DOWN APPROACH

The indoor environmental parameters – thermal comfort, air quality, acoustical quality and lighting quality – are thus being defined and identified with quantitative indicators that are mostly expressed in numbers and/or ranges of numbers assumed to be acceptable for humans. However, these are only valid if a clear relation has been established between the parameter and a specific health or comfort effect, and when the interactions with other parameters are known (Figure 1).

It is clear that new ways of managing the indoor environment are required. Hence the proposal is put forward that the indoor environment should be considered as a system (Figure 2) analogous to system engineering using a top-down approach, as seen in the aerospace industry[13]. In this approach, the subsystems (components) matter, but the system will only function if all sub-systems are optimised along with the total system, whether this is related to health, comfort or sustainability issues. This top-down approach allows for a holistic and integrative management during the entire life-cycle of an indoor environment from initiation to breakdown. In this context, 'holistic' means focused on end-user requirements, integrating all aspects and covering interactions between occupant and environment and vice versa.

In addition to this top-down approach, some kind of risk assessment is needed in which the traditional bottom-up approach is used in parallel with the top-down approach – a risk assessment that makes use of clearly identifiable relations found between certain building characteristics or user patterns and self-reported health complaints[14]. When relations between certain building characteristics (measures) and (health) complaints are known, it becomes possible to set new or different guidelines (performance indicators and performance criteria) and evaluation methods, based on which new building concepts can be realised. An inventory of measures that should be followed in order to get to a healthy and comfortable building with the current knowledge available is a good start.

NEED FOR R&D

It is clear that there is a need for a test procedure that evaluates the effects and reactions of people to different environmental conditions over time in order to define a human model. With respect to food, we have been brought up to communicate what we like – within certain limits, we can inform the cook what we want in terms of salt, sweet, bitter and sour. For a house, or for that matter the function of living, we are much less educated. In most cases we are confronted with an existing house or design and have to fulfil our needs within those boundaries.

On the other hand, most people cannot indicate or pin-point their physical and mental needs, which makes performance-on-demand of the end-user difficult. There is often a discrepancy between what people tell us and what their behaviour tells us, or what they say is the cause of certain complaints and what the real problem is. The reason lies in the ways we process information – consciously (cognitive) and unconsciously (emotional). Understanding this processing at physiological and psychological level is thus important in order to model or predict human behaviour under different environmental conditions. We need new techniques (biosensing and biomonitoring) from other fields of science to understand behaviour and physical reactions by observing and monitoring both positive and negative effects of stimuli.

It should be emphasised that climate change effects and changing end-user requirements (not being the same as 100 years ago) are not to be forgotten. They will have an effect on the design of buildings, materials used, services and control systems. Up to the 19th century, for most people the indoor environment was merely a place for shelter, to sleep and eat. But in the future, the enclosure of a building will more than ever need to integrate the different functions of the building, complying with climate change imperatives (e.g. saving energy), providing comfort and health for the end-users.

However, saving energy at the same time as creating a healthy and comfortable indoor environment requires more than providing an efficient and sustainable envelope – control of the indoor environment parameters is very important as well. This control should anticipate conscious and unconscious needs of the different end-users in relation to different activities. This anticipation can vary from complete central control to individual manual control of an individual's personal space (e.g. performance on demand, adaptability and flexibility). Sensors and signals are key issues to anticipating human demands and behaviour. Sensors are no more than systems that measure signals from the environment and individual people. However, if the determinants or indicators of a certain wish or demand are unknown, it will be difficult to pinpoint the sensor required for providing control. Without knowledge of cause and effect, an indicator will provide nothing more than a wild guess.

Dr Philomena Bluyssen works with TNO Built Environment and Geosciences in Delft, the Netherlands. She has written more than 150 publications and co-ordinated several European-funded projects on indoor environment, including the European Audit project and the recent European HealthyAir project.

Figure 1
Examples of interactions at different levels[11]

Human being	Parameters indoors	Building and elements	External environment
Physical and physiology	Indoor chemistry microbiological growth	Integrated systems	Ageing population Multifunctional society
Mental and psychological	(fine) dust	Smart Control	Climate change and related issues
Concious and unconscious	Noise and vibrations	Flexible bearing construction	Metaphysics
Health and Comfort	Healthy lightning	Indoor surfaces	Risk assessment

Figure 2.
A system for sustainable health and comfort (based on Bluyssen, 2009[10])

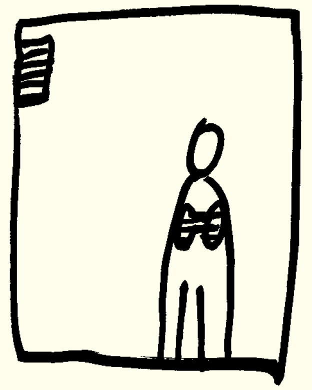
Human being	Indoor environment	Control	Holistic and integrative top-down approach
Performance indices integrating health and comfort aspects	A sustainable indoor environment that guarantees a high basic level of health and comfort	Performance on demand, anticipating wishes and needs during different activities and over time	End-user focused, multi-disciplinary, life-cycle oriented, sustainable

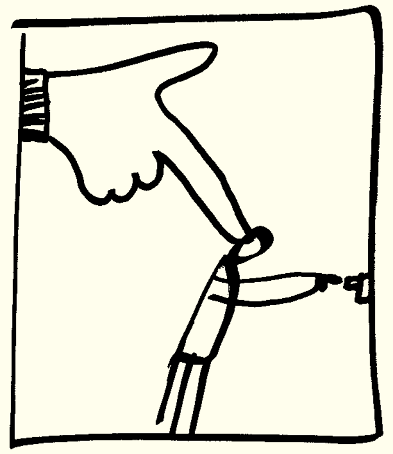
Notes

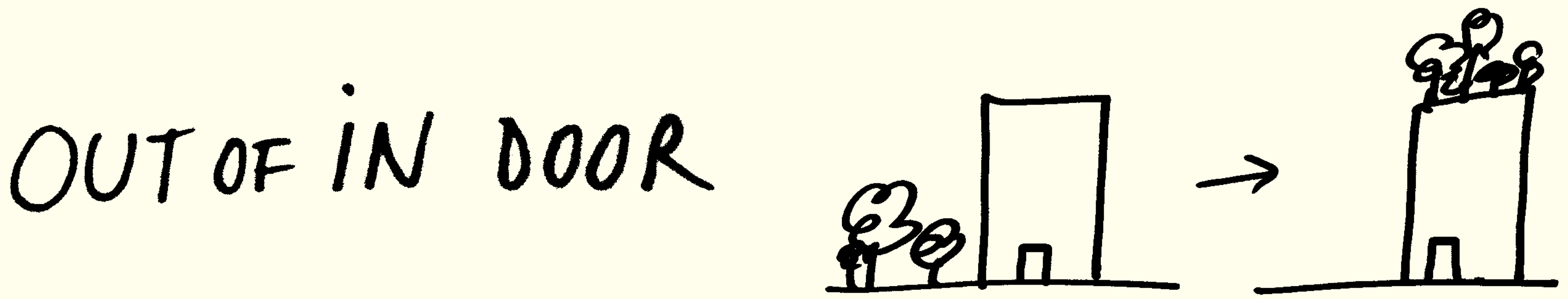
1. Rowland, I.D., Howe, T.N. (2007) Vitruvius: Ten books on architecture, Cambridge University Press, Cambridge, UK, ISBN 978-0-521-00292-9.
2. Madigan M, Martinko J., Parker, J. (eds) (2005), Brock Biology of Microorganisms, 11th ed., Prentice Hall, ISBN 0131443291, New Jersey, USA.
3. Billings, J.S. (1883) 'Ventilation and Heating', The engineering record.
4. Billings, J.S., Mitchell, S.W., Bergey, D.H. (1898) 'The composition of expired air and its effects upon animal life', Smithsonian Contributions to Knowledge, Washington, USA.
5. Janssen, J.E. (1999) 'The history of ventilation and temperature control, the first century of air conditioning', ASHRAE Journal, October, pp48-70.
6. Encyclopaedia Brittanica (1991) Macropaedia vol.23, 15th edition, 'Chapter light pp.1-28 and chapter lighting and lighting devices', pp29-38, ISBN 0-85229-529-4, Chicago, USA.
7. Encyclopaedia Britannica (1991) Macropaedia, vol.27, 15th edition, 'Chapter Human sensory reception', pp163-221, ISBN 0-85229-529-4, Chicago, USA.
8. Kapit, W., Macey, R.I., Meisami, E. (2000) The physiology coloring book, 2nd edition, ISBN 0-321-03663-8, Benjamins/Cummings Science publishing, CA, USA
9. Taylor, J. (2006) The mind, A user's manual, John Wiley & Sons, Ltd., England, ISBN 0-470-02222-1.
10. Bluyssen, P.M. (2009) The Indoor Environment Handbook, How to make buildings healthy and comfortable, Earthscan, London, UK, ISBN 9781844077878.
11. Bluyssen, P.M. (2008) 'Management of the indoor environment: from a component related to an interactive top-down approach', Indoor and Built Environment, vol.17, issue 6, 483-495.
12. Bluyssen, P.M. (2010) 'Towards new methods and ways to create healthy and comfortable buildings', Building and Environment, vol.45, issue 4, 808-818.
13. Blanchard, B.S. (2004) System engineering management, third edition, John Wiley & Sons, Inc., ISBN 0-471-29176-5, New Jersey, USA.
14. Roulet, C.-A., Bluyssen, P.M., Cox, C. and Foradini, F. (2006) 'Relations between perceived indoor environment characteristics and well-being of occupants at individual level', Proceedings of Healthy Buildings 2006, Lisbon, Portugal, vol.3, 163-168.

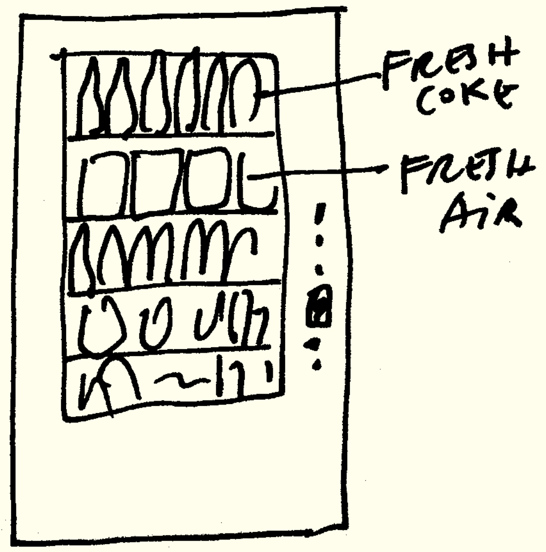
Dan Perjovshi

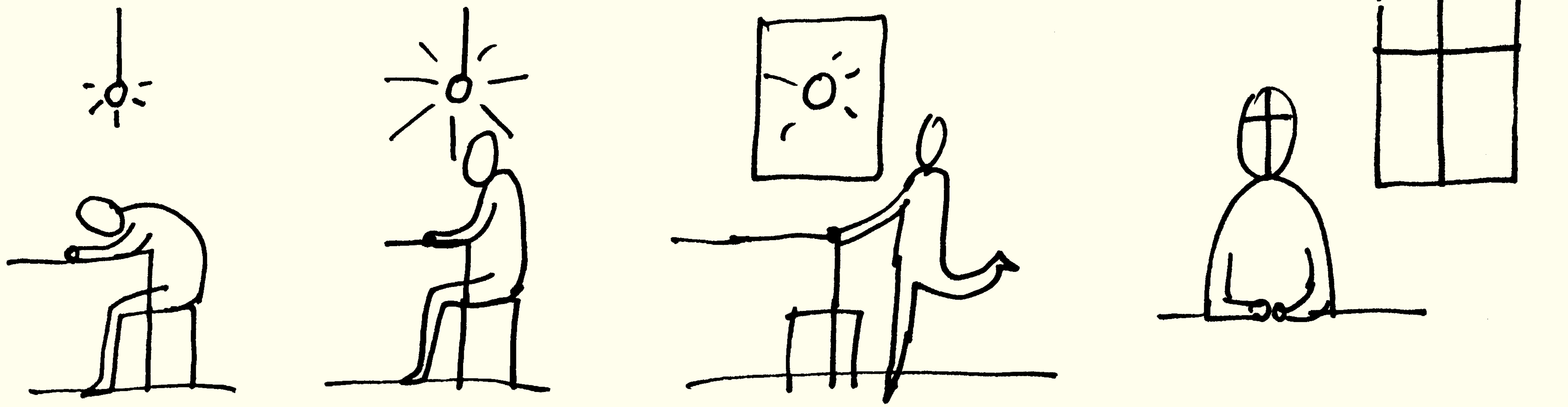
Dan Perjovschi is an artist, writer and cartoonist born in 1961 in Sibiu, Romania. Perjovschi has over the past decade created drawings in museum spaces, most recently in the Museum of Modern Art in New York City in which he created the drawing during business hours for patrons to see. The drawings present a political commentary in response to current events. Another exhibition of Perjovschi's within a Portuguese bank consists of several comic strip style drawings which address more European issues such as Romania's acceptance to the EU and abortion legalization in Portugal.

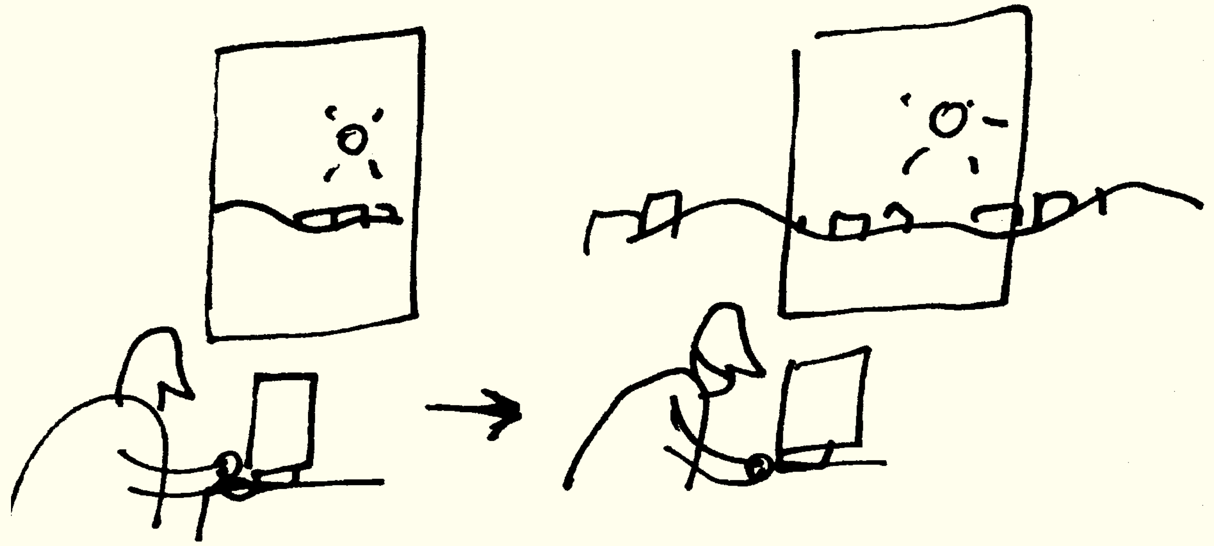


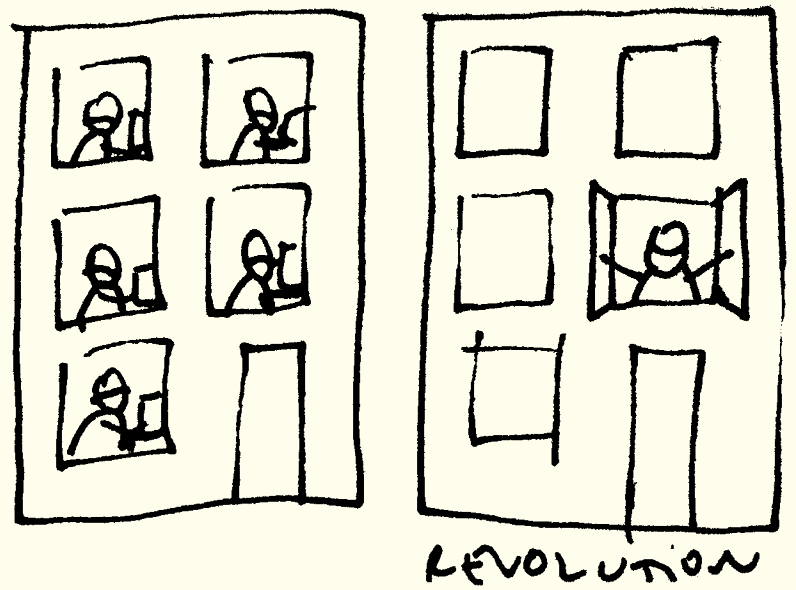


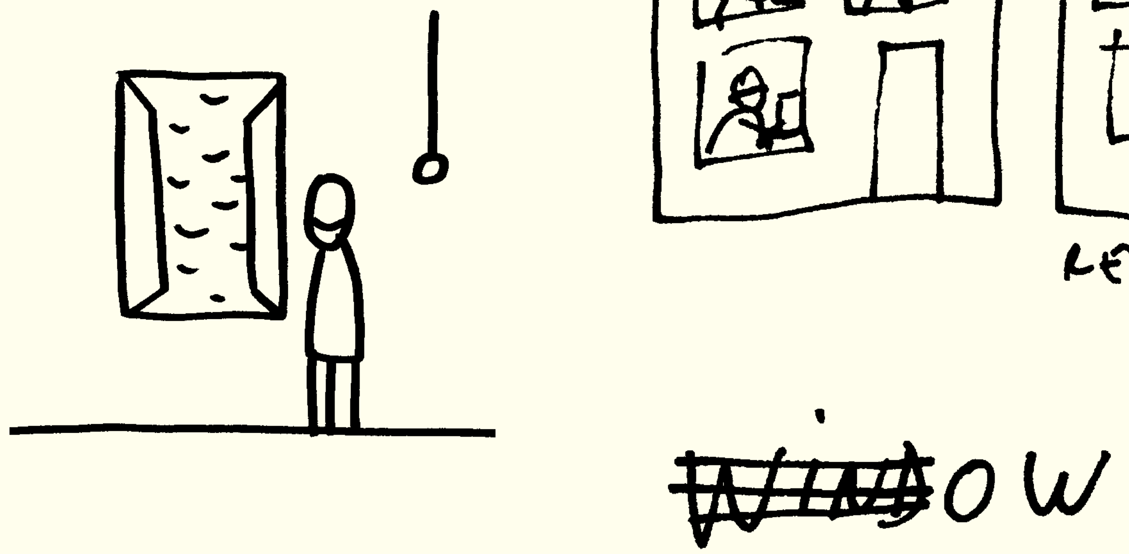


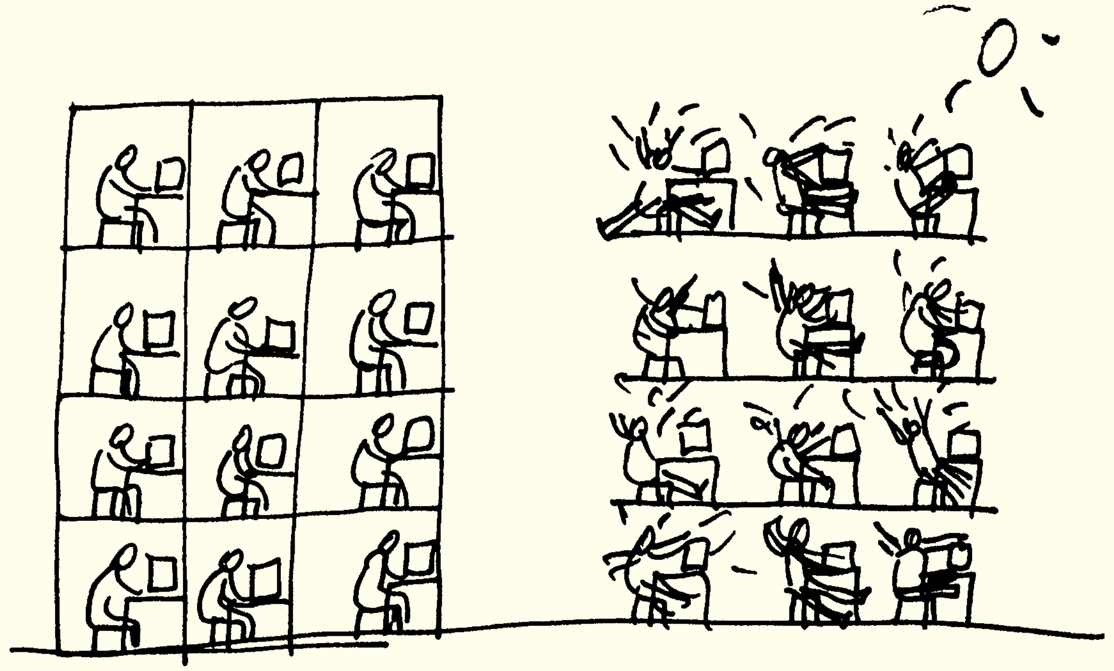


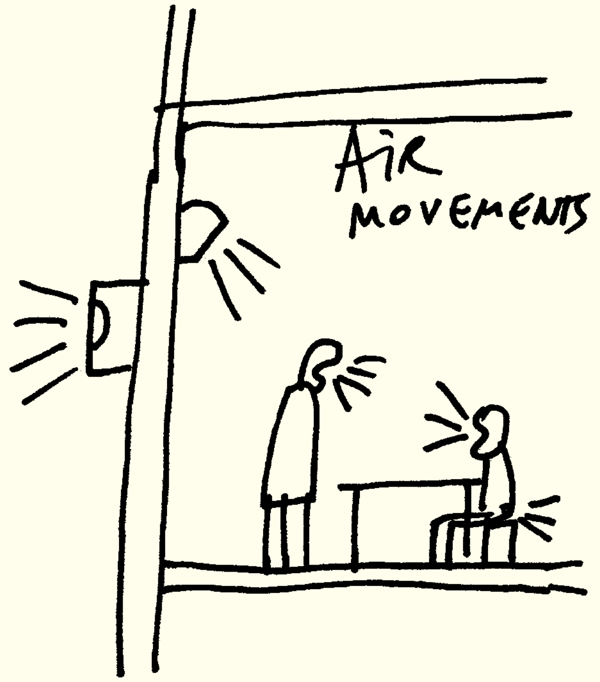


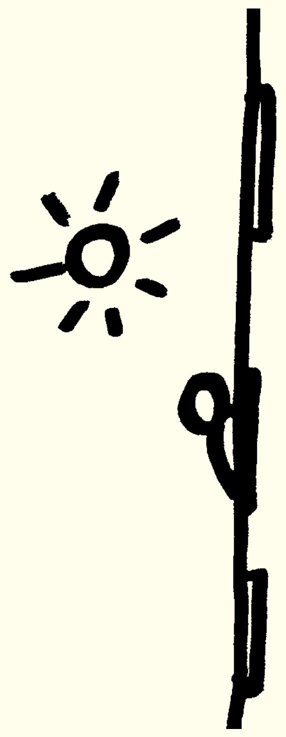












Mankind as the focal point of architecture: interior views of a corresponding relationship.

A BREATH OF FRESH AIR

WINDOWS IN A MORE NATURAL ENVIRONMENT

By Fred Pearce
Illustrations by Dan Perjovschi

The days when architects expected buildings to provide total automated control of the indoor environment are over. Inhabitants of houses, offices and factories prefer access to daylight and fresh air. Not only that, it is good for their health and their productivity. So how can the designers of buildings best deliver?

MOST OF US spend most of our time indoors. Yet the indoor environment is discussed much less than the outdoor environment. The presumption is that we are safe indoors. Buildings provide shelter, warmth, shade and security; but they often deprive us of fresh air, natural light and ventilation. Can they do better?

Once, to address such concerns, we might have relied on ever-more controlled indoor environments. More recently, however, architects have started to commit what might once have seemed heresy – considering whether we should let more of the outdoors indoors, whether we could improve our health and our mental well-being by giving up total control of the indoor environment. As a result, buildings are increasingly going back to nature, with natural ventilation and natural lighting.

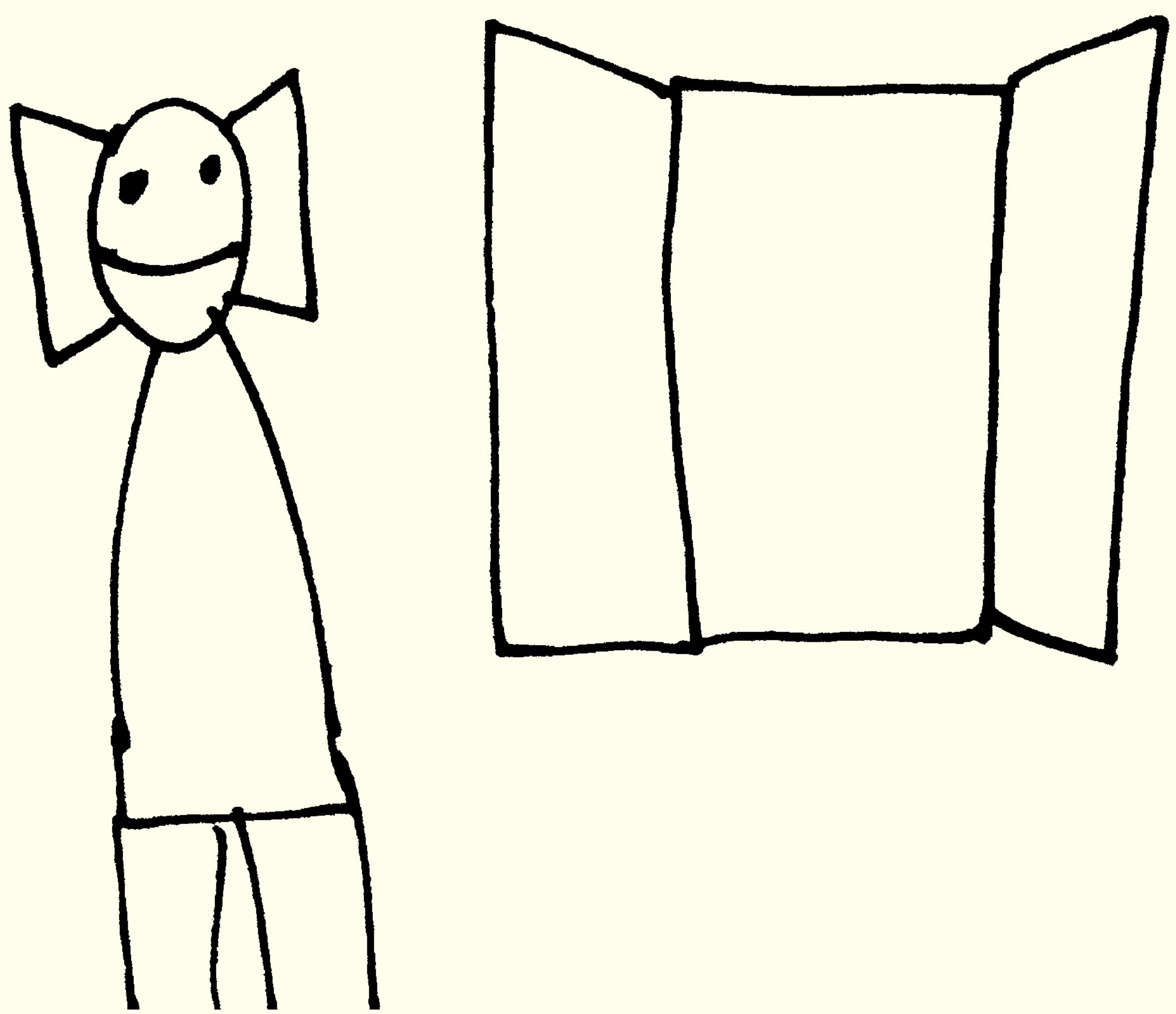
VENTILATION

All buildings need ventilation to maintain good air quality. But, especially in cold climates, there is a trade-off between ventilation and energy consumption. If we want to cut the amount of energy we use for heating buildings (or air conditioning them in tropical summer), an obvious way is to control ventilation. With more than a quarter of our primary energy going to heat and air condition buildings, the consequences of these choices, for both cash and carbon emissions, are huge. So where is the right balance? Can well-designed buildings deliver both energy savings and good air quality?

As a rule of thumb, homes should be designed so that half the air is replaced every hour. Many building codes incorporate this. Lower rates "are a health risk in residential buildings", says Olli Seppanen, head of the Institute of Heating Ventilating and Air Conditioning at the Helsinki University of Technology. And some leading experts, such as Jan Sundell of the International Centre for Indoor Environment and Energy at the Technical University of Denmark, suggest that a higher figure of 0.7 replacements per hour is better for inhabitants. Yet many modern homes do not even meet the lower target. Hourly air replacement rates are often no more than a third, especially in northern Europe. And the trend has been towards reduced ventilation, in order to save energy. Typical ventilation rates in Europe have halved in the past half century.

In schools, offices and other work spaces, ventilation is usually measured in terms of the volume of air replaced per person in the space. According to Seppanen, ventilation rates below 10 litres per second per person are associated with significantly less healthy environments and lower productivity. And ventilation rates of 25 litres may be necessary to eliminate health risks and discomfort. But again such targets are often missed, as companies reduce their energy bills by reducing ventilation.

Ventilation disperses irritants and unhealthy substances that may accumulate in enclosed spaces. These include bioeffluents from human exhaling and activities; chemicals from building materials and cleaning agents, etc.; moisture; and the moulds and microfauna that thrive in a humid atmosphere. Dust mites, which can trigger a range of allergic reactions, do well if indoor humidity is above 45 per cent – a frequent occurrence when hourly ventilation rates are less than 0.5 replacements per hour. According to the World Health Organization, up to 30 per cent of new buildings show symptoms of "sick building syndrome", causing headaches or even asthma attacks among inhabitants. There are also longer-term threats from poor ventilated buildings. Poorly ventilated buildings may accumulate cancer causing particles from cigarette smoke, asbestos from flaking insulation or lead from old plumbing and paint. They may contain higher amounts of potentially dangerous artificial compounds such as brominated flame retardants used to prevent furnishings and carpets from catching fire. A further threat is from the radioactive gas radon and its decay products, which percolate into basements and foundations from granitic rocks in some regions. Epidemiology suggests that in Denmark, Britain and elsewhere there may be hundreds of deaths each year from radon-induced cancers.



Indoor air quality
Indoor air quality and ventilation have been shown to affect the productivity of workers and school children. In a pioneer study by Pawel Wargocki in 2000, it was shown how the productivity of office workers is improved by some 2% when the ventilation rate is increased from 3 l/s to 30 l/s. A later study by Wargocki in 2008 on the performance of school children showed that doubling the ventilation rate in schools can improve performance by 15%.

Generally ventilation improves indoor air quality, but ventilation is not all the same. There is a growing understanding today of the difference, both in the quality of air delivered and in how it is perceived, between mechanical air conditioning and natural ventilation. Natural ventilation covers everything from windows freely controlled by inhabitants to controlled air exchange using differences in air pressure and windows that open and close automatically.

Sick building syndrome is more prevalent in air-conditioned buildings. The explanation for this is not always clear, but the poor performance of mechanical air conditioning is probably related to badly-sited intakes for 'new' air and a failure to replace filters handling recycled air. Other factors may include dirty cooling towers, where legionnaire's disease may lurk, and the circulation of fibres from ducts and other equipment.

"Overall, most studies show more people satisfied with their working environment when exposed to natural ventilation rather than air-conditioning," says John Hummelgaard of the International Centre for Indoor Environment and Energy at the Technical University in Denmark. "They prefer the direct exchange of air from the outside. And under those circumstances they are more tolerant of minor discomfort."

So there is a win:win situation here in the balance between health and well-being on the one hand and energy efficiency on the other. Automated natural ventilation systems typically use 10–30 per cent less energy that air-conditioning systems, according to Andy Walker of the US National Renewable Energy Laboratory. Thus natural systems have lower energy costs and greater user satisfaction.

THERMAL COMFORT

Ventilation is closely tied to thermal comfort. Studies over many years have concluded that all of us, whatever our race, whatever our wealth or lifestyle, whatever the season, and wherever we live, have a similar thermal comfort zone. When at rest or engaging in light activity such as working at an office desk, we like a temperature of about 22 degrees Celsius. That is the theory, and it has led to ever more concerted efforts to stabilise temperatures in buildings around this figure, using highly mechanised heating and cooling systems.

And yet we are not so inflexible. More recent research has suggested that, as with ventilation, if we have control of the temperature in our working environment, we are more tolerant of temperature variation. With natural ventilation, people in an office at 30 degrees may still regard the temperature as quite acceptable, even though they would protest if the ventilation were mechanical.

Richard de Dear, an architect at the University of Sydney, carried out a meta-analysis of research data and concluded that the definitions of thermal acceptability incorporated in the standards of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) "bore little resemblance or relationship to the levels actually expressed by occupants". People were generally much happier to accept whatever temperature their building was at than previously supposed. And "this adaptive relationship was stronger in naturally ventilated buildings".

He concluded that the acceptable range of temperatures is about doubled in naturally ventilated buildings. How much of this was due to physiological acclimatisation to variability and how much to shifting expectations is not clear.

Human response to differing temperatures shows many interesting wrinkles. High humidity usually makes us feel hotter, for instance. Likewise glare from the sun shining directly through a window. And a light breeze through the office, whether from open windows or an air conditioning system, creates a 'chill factor' by removing heat from the body faster.

And our perceptions of air quality depend on temperature. Studies by Pawel Wargocki, Lei Fang and Ole Fanger have all found that air should be served as we prefer champagne: cold and dry. The quality of air is perceived as being better when it is cold and dry, rather than warm and humid.

Knowing that high indoor temperatures are not necessarily uncomfortable in naturally ventilated buildings, a goal

"Enough light to see by is not enough light [...] The daily light dose received by people in Western countries might be too low, possibly detrimental to our well-being."

Jennifer Veitch, Canada's Institute for Research in Construction

could be to design buildings without air conditioning that make people feel comfortable. This will have a growing influence on window design. Can we have windows that provide ventilation but do not create a breeze (which in any event can play havoc in a paper-strewn office)? Can we have windows that let in light but shade us from glare? And most importantly, while designing new buildings with window systems with an increased number of functions, we should remember to keep the occupant in focus and never take the control of the systems out of the hands of the people occupying the spaces we built.

LIGHTING

Once we illuminated our rooms with natural light to the maximum extent possible. As late as the 1940s, artificial light only took over after dark. But since then, the desire for total control over lighting, especially in the workplace, has encouraged ever greater reliance on artificial lighting. And the only measure of whether the light is correct has been whether the quantity of light provided enough illumination to see by. But in recent years the short-sightedness of this approach has become apparent. "Enough light to see by is not enough light," says Jennifer Veitch of the National Research Council of Canada's Institute for Research in Construction. "The daily light dose received by people in Western countries might be too low," she says, "possibly detrimental to our well-being."

More attention is now being paid to the quality of light, and to the subtle but potentially far-reaching effects of lighting levels and the spectrum of light, along with the influence of the timing of our exposure to light in its many forms. The implications range from our sense of well-being, the incidence of seasonal affective disorder (SAD) and recovery from jet lag to long-term effects such as our bodies' supplies of Vitamin D, cancers and immune function. And light is not the only issue. We also need "healthy darkness" to maintain our body clocks. We need, says Veitch, a "daily dark dose."

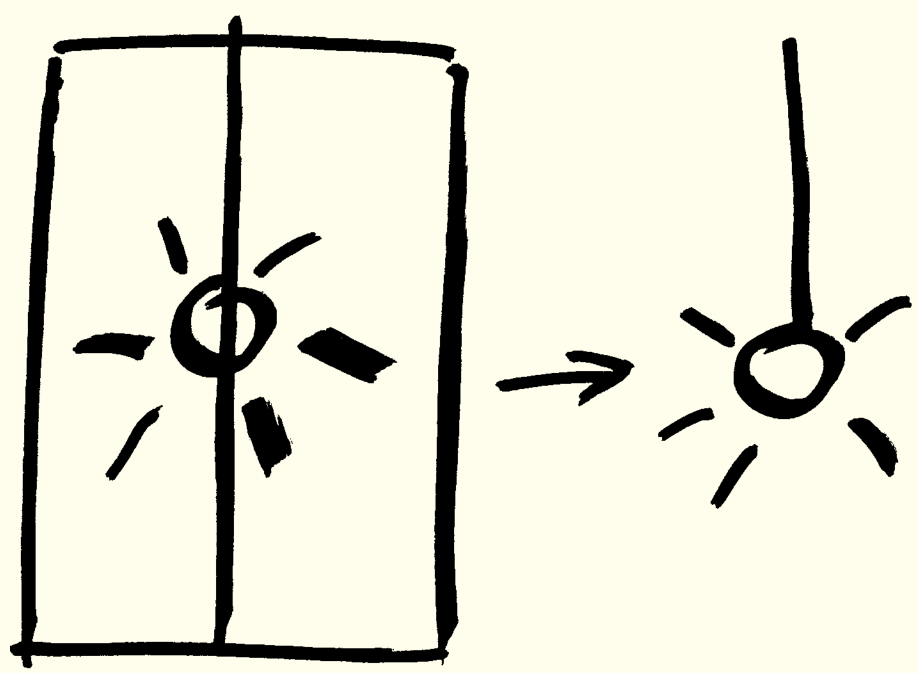
About half of solar energy is in the visible part of the spectrum, the rest being either ultraviolet or infrared. Visible light occupies the electromagnetic spectrum from around 380 nanometres to 780 nanometres.

Daylight, though strong in all areas of the spectrum, changes throughout the day. Electric light is a poor proxy for daylight. It has a generally much narrower range than daylight, and none of the variability. Extensive studies performed by Heschong Mahone Group, and based on student performance data from over 21,000 students in 2000 classrooms in California, Seattle, Washington and Colorado, have found a compelling statistical correlation between the amount of daylighting in elementary school classrooms and the performance of students on standardised maths and reading tests (see separate box).

Other studies also suggest that natural light is better for us – that we can benefit from a 'daylight dividend'. A sunny hospital room almost halved death rates among patients recuperating from a heart attack, according to University of Alberta health scientists Kathleen Beauchemin and Peter Hays, in a paper called Dying in the Dark. They also found sunlight helps patients suffering from depression. Another study found that hospital rooms that overlook natural views also aid patient recovery more quickly than those facing a brick wall.

A literature search by Paul Torcellini of the US government's National Renewable Energy Laboratory found many sources claiming that more daylight brought better industrial and office productivity. Lockheed Martin claimed that more daylight in its engineering design offices was responsible for reduced absenteeism and increased productivity that helped win a $1.5 billion defence contract. Other American organisations have claimed increased productivity of 15–25 per cent after moving to new buildings with better lighting. The Reno Post Office said the resulting increased productivity paid for its new building in under a year.

Daylight
Daylight availability has been shown to affect the learning progress of school children. An extensive study performed by the Heschong Mahone Group, based on student performance data from over 21,000 students in 2,000 classrooms, found that students in classrooms with the largest window area progressed 15% faster in maths and 23% faster in reading than those with the least window area. Students that had a well-designed skylight in their room (one that diffused the daylight throughout the room and that allowed teachers to control the amount of daylight entering the room) also improved 19–20% faster than those students without a skylight. The study also identified another window-related effect – students in classrooms with windows that could be opened were found to progress 7–8% faster than those with fixed windows. This occurred whether the classroom also had air conditioning or not. These effects were all observed with 99% statistical certainty.



LIGHTING AND CIRCADIAN RHYTHMS
Natural light reinforces our daily rhythms. We are genetically programmed to respond to light stimulation to wake up in the morning, stay awake through the day, and sleep at night. Without enough daylight, and darkness, these processes can suffer. This may be more frequent than we often imagine.

Most workplace lighting is poor compared to daylight, particularly in the middle of the day. And this seems to suppress our ability to keep alert and work efficiently. Certainly, studies consistently show that people exposed to brighter than normal lights in the office work better, are more alert and have a happier mood – in the afternoon in particular. They may also sleep better at night, according to Ann Webb of the School of Environmental Sciences at the University of Manchester.

The main timepiece for this body clock appears to be a series of cells in the back of the eye unconnected to sight. These cells send messages via the hypothalamus area of the brain to the pineal gland, also in the brain and sometimes called our 'third eye'. The pineal gland secretes the compound melatonin at high rates during darkness and at much lower rates during the day. Melatonin controls our wakefulness.

These cycles are known as circadian rhythms, from the Latin circa (meaning around) and dies (meaning day).

Our bodies are also responsive to seasonal changes in exposure to light. Our circadian rhythms respond to these seasonal changes, allowing people in high latitudes to sleep more in winter and less in summer. But these systems do not always work perfectly – perhaps in part because many people today are much less exposed to the quantity, quality and rhythms of daylight. This may be at the root of a form of depression known as the seasonal affective disorder (SAD) that afflicts suffers during autumn and winter, as the days grow short. As much as 10 per cent of the population may suffer symptoms of fatigue, feeling low and inability to concentrate on work.

One theory is that SAD is caused by a phase delay in the circadian system. Certainly, like jetlag, in many sufferers it can be alleviated with exposure to regular doses of bright light, whether artificially or from an outside walk each morning. Theory suggests that light rich at the blue wavelengths ought to work best in attenuating the symptoms, though whether this gave rise to the colloquial expression 'feeling blue' is unclear.

All this suggests that there are major gains from exposing workplaces to more natural light, and from switching to artificial light that more closely mimics natural light in quantity and quality. Building design in particular can enhance overall light during daytime and ensure that people get sufficient morning exposure to the blue light that at this time of day bolsters circadian rhythms and may ward off SAD and other health-threatening conditions. Much of this comes back to windows – the most important link between the indoor and outdoor environments, the source of natural light and natural ventilation.

In the past, the exclusive concentration on electric light as a source of illumination has blinded architects and lighting designers to many of the other auxiliary benefits from natural light – including keeping a workforce alert through the afternoon. Wake up there at the back.

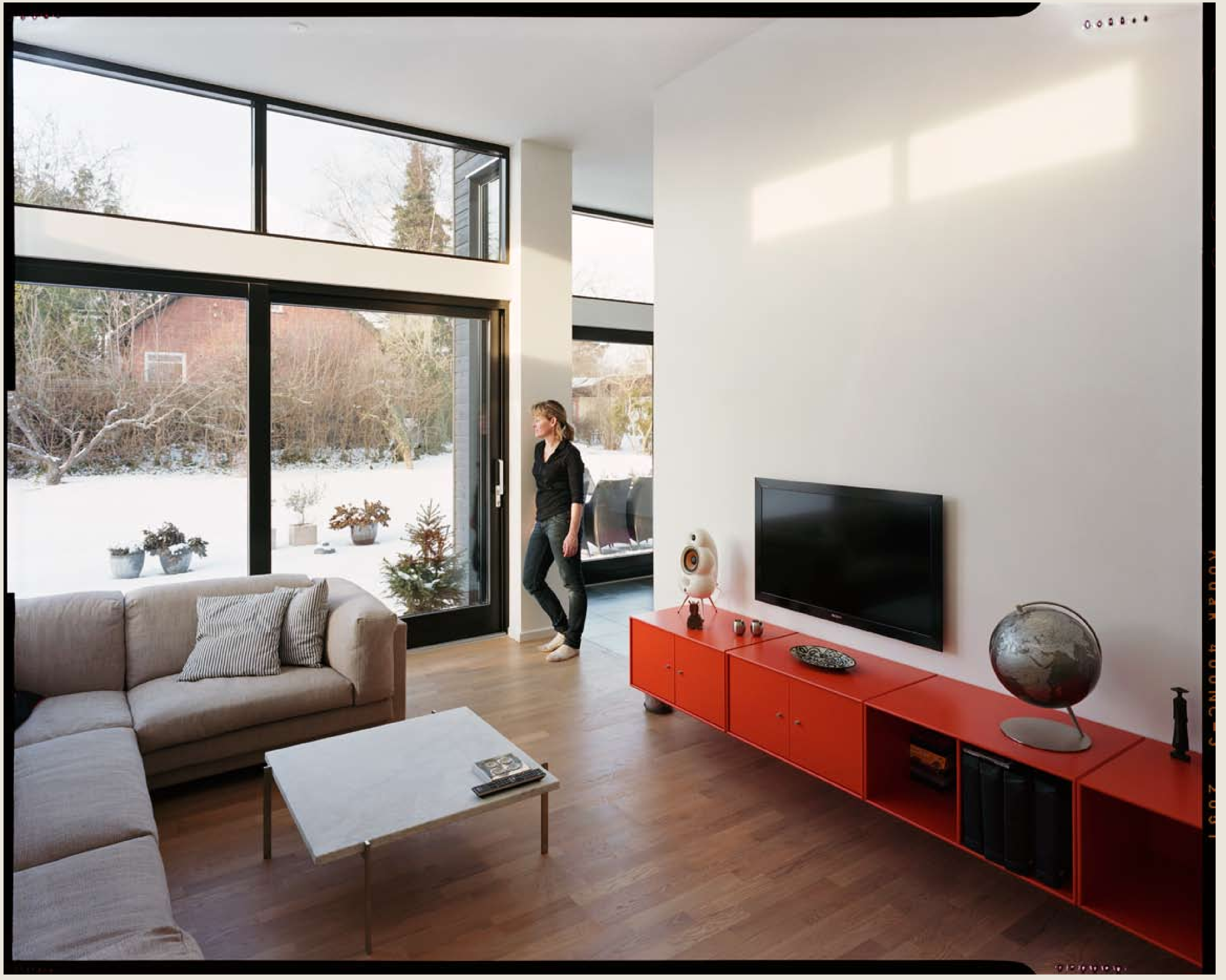
The good news for architects then, is that there are practical ways of combining the necessary control to provide an optimum – the right lighting, ventilation and temperature – with the needs and desires of the occupants of buildings to control their environment and to feel 'in touch' with the outside world. Harmony between indoors and outdoors is possible.

Fred Pearce is an author and freelance journalist based in London, UK, Fred Pearce has reported on environment, science and development issues from 64 countries over the past 20 years. He is environment consultant for New Scientist magazine and writes the Greenwash column on the Guardian web site. He has published more than a dozen books including When the Rivers Run Dry, The Last Generation and Confessions of an Eco Sinner.

FRESH AIR AT HOME: A SENSORY EXPERIENCE AND SOCIAL RITUAL

By Bettina Hauge
Photography by Felix Odell

In a qualitative study conducted in autumn 2009, the Danish anthropologist Bettina Hauge has shown how people make use of fresh air to air out their private homes. Her analysis of the results shows that ventilation practices may be divided into three categories: functional (practical causes), aesthetic (sensory) and social (caring for and impression on others). Anthropological studies of this kind are useful in understanding why people act the way they do, and analyzing specific practices may give hidden insights into the lives of ordinary people.



"Airings and fresh air are funny things.
you don't talk about them, you just do them."
Mariann

The importance of airing out by opening windows and doors is particularly important in 'transition periods' – like getting from work to home, returning from holiday to everyday life, adapting from summer to winter and adjusting from being asleep to being awake. This is in accordance with knowledge gained from anthropological ritual and behaviour research that reveals the importance of behavioural patterns in the transition from one phase to another. Transitions often involve the feeling of freedom and the need for control – in this case control of the family's health and well-being through control of the domestic environment. In other words, opening windows and doors demonstrates a sense of caring for the residents of the house.

Opening a window or door indicates, for all informants in the study, bodily receptiveness and inclusion of the outside world. This is in line with phenomenology that indicates that we are part of this world through our bodies – it is through them that we are aware of our existence. In this light, 'enjoying a breeze' becomes the joy of being alive. Having a 'nice fresh smell' in the home is a phenomenological desire that indicates being alive and not decaying – a desire to remain receptive to the world and to developments. Opening the window of the children's room to let in fresh air is a way of greeting the morning by demonstrating one's relationship with the surroundings – as well as love for the children.

Airing out is:

- habitual and ritualised (repetitive, seasonally-determined behaviour)
- physically determined, a purely sensory experience (a fragrance lingers in the nose; individual comfort zones; enjoying the breeze)
- socio-culturally determined – partly because airing out can be linked to risks (fear of radon or water damage) and with certain taboos as fresh air IN means particular smells OUT (from lavatories and bedrooms). For this reason, control of the odour spectrum of the home is desired.

In the study people spoke of themselves as either a 'window opener' (mostly women) or a 'window closer' (mostly men). The report also presents statements from children and young people that show they have their own view of the ritual of airing out that reflects partly the body's various comfort zones and partly a contextual significance: a slim girl does not want to open windows as she gets cold too easily – and her brother automatically airs out a soldier's barrack room so as to be able to sleep in it, a habit that, much to his parents' dismay, he does not practice as much at home. This also serves to illustrate that habits are determined by the situation and not only the technical features of the home.

Reasons given for opening up the house and letting in fresh air reflect the functional, emotional (social) and aesthetic (sensory) elements of fresh air through windows and doors. They cannot be taken out of context; it is very important to see them in the light of their importance in the home. The home as the framework for family health plays a role in our practice of airing out, just as the social status of the home in the form of an 'odour spectrum' provokes particular airing out behaviour.

Airing out involves the general concept of having a good indoor climate that covers many other parameters than fresh air alone:

Fresh involves:

- anti-smell, perception (being aware of the world and the present)
- thinking about the entire family's health (banishing the bedroom odour, dust and bacteria)
- satisfaction (completely individual need)
- a through breeze (freedom)

Air involves:

- smells and sounds in context (from the countryside or town, the pleasure of being able to follow the seasons)
- technology (systems for controlling air that allow the user to forget about taking steps personally to air the home – i.e. the need for security, personal control of doors and windows)
- control (the ability to control the home-cleanliness and healthiness)
- practical functions (cleaning).

By far the majority of the aspects mentioned above are determined by the house as a frame for 'impression management' - the social construction of smell – in relation to the desire for how we wish to experience and perceive our own homes and how we wish visitors to experience and perceive us and our homes. Your home is your *smell*.

Bettina Hauge holds a Master's degree in Anthropology from the University of Copenhagen and a PhD in Sociology. She is employed at the University, currently engaged in carrying out research on young people, their environmental views and their related practices at home. She has conducted various research projects in the field of technology and human interaction, most recently in the field of user-driven innovation and intelligent housing. Bettina Hauge teaches both at the University of Copenhagen and at the Danish Technical University (DTU).

Mariann (left)
"As soon as I'm up and dressed in the morning, both windows are thrown open. Fortunately, we both agree on that. I would guess they are open for 30–40 minutes before we leave home. The window is open while I'm in the bath too. In fact they're open all year round – the bedroom windows that is. It's a pure reflex. About every third day I air out the house with a draught – I have to feel that I get fresh air. The air must not stand still – that's not pleasant. I also always open the window when I use the vacuum cleaner. And of course when it's hot weather. [...] When I get home from work, I often leave the kitchen door open – and the window. It's Ole who's the closer! When we're finished in the kitchen – 20 minutes or so later I s'pose – we close them. In the summer they're open all the time. Well, depending on the weather of course. Not so much in the winter." (left)

Charlotte (p.36)
"I air out when we wake up in the morning and when the oven's on – but there are no hard and fast rules about it. When it's really hot I prefer to keep windows and doors shut. The bedroom window is kept open – thankfully my husband and I agree on that - and I open the windows in the children's rooms a little before they go to bed. The 12-year-old opens her window in the morning but not the 10-year-old. So I normally remind her about it. And the little one can't do that herself of course.

When we have guests we open more windows than normally because it gets SO hot in here. That creates a little circulation – we make sure there is a bit of a draught so we can cool the place down quickly. From May to September, we turn off the underfloor heating. And the log stove is just for cosiness. [...] But you should be able to sense and smell that the house is lived-in – that it's being used."

Bella (right and p.42)
"The older generation probably thinks more about use of resources – waste not, want not. We've always tried to live up to that so perhaps it's not an age thing – more something to do with the body's sensitivity as to whether you like to let the fresh air in or keep it out."

[Question: If you haven't aired out?]
"It's almost the same as if I hadn't cleaned. It has something to do with being awake. I also do it when I get home after dropping off the boys before I start the day's work. I would have thought that those low-energy houses, where it's almost forbidden to open the windows because it ruins the central heating effect – well that's a big minus [...]. I wouldn't like that at all. And even if I have SolarVenti [a solar hot air collector for ventilation] in this house one day, I'll still open the windows. I mean for all the extra things you get when you air out. I also want to be able to create a draft – it's uncomfortable if you can't adjust the temperature fast. No, the wind must be allowed in."

Janne (p. 34)
"I've changed my fixed routines beyond recognition [since I moved house]. Every single day I used to have to dry all the windows in the bedroom. The condensation ran down the edges and they can't take that. Today I think it's all very different. Such a relief! In my old house I HAD to do something, now I have almost no fixed routines any more, about airing out I mean. But if it's good weather, if it gets too hot, then I open the windows. In fact the windows in my old home were practically the reason we moved. We had decided to replace them but it turned out to be a huge project because they were fixed to their frames in a special way - so a big chunk of the wall would have to be knocked down and built up again. No way. We'd rather move to something new."

Anne Margrethe (p. 43)
"Normally I air out just to get the air in the house circulating. I tell myself that the air from outside is fresher. The morning fug must be got rid of and fresh air helps there. Fresh air should almost go through your body I think – and not stand still. It's also to sort of get the sleep out of the house, know what I mean? Like getting the sleep out of your body. For me, airing out is something that is both mental and physical. [...] It's something that you think makes you feel better. Pure routine. You say 'good morning' when you open the windows. That's also because you can hear the wind in the trees. I mean you get fresh air but you get something else too. The owl and frogs at night. Oh what a racket they make – sometimes it's a real concert. But that's what's so wonderful."

Ghita (right)
"Fresh air must be allowed in – it's really nice to let the breeze in. At bedtime – ten minutes before and after we've gone to bed. I open. Jan closes. Of course it's irritating if mosquitoes, daddy longlegs, flies and wasps get in. I don't want that at all. I hate it. We always open the windows before we go to sleep. In the summer they are slightly open all the time. I still remember the sounds of the city when we opened the windows in the evening in Copenhagen. Here there are different sounds, the sounds that belong to nature."

Jan (right)
"After the winter, it's so fantastic to hear the birds in spring. I look forward every year to hearing the birds. It makes me happy."

Ghita
"Yes, then summer is on the way – great. Yes we air out but not enough. In the kitchen too – we turn on the cooker hood – but I think it makes so much noise and we switch it off as soon as we can. We should have fitted the motor outside the house."

Margit

"...Then after breakfast I go back upstairs, finish off in the bathroom and jump into my clothes. I make the bed and open the window wide – I must let fresh air in because the bedroom has to be aired. I couldn't dream of not turning the duvet and opening the window. I leave it open for a bit while I finish getting ready. [...] I've always done that – always aired out like that. I've always made my bed and opened the window extra wide. Seems the right thing to do somehow.

When the children lived at home, I just opened more windows. They made their own beds and learned to open windows too. It just comes naturally, I think, to air out when you do the beds. In the summer, the windows are always left a little bit open because it gets hot, really hot, and they are open day and night all summer long. I try to get a little air circulation going so I open the windows to make a draught – that's in the bedroom and the room opposite, my home office."

The study in a nutshell

The study employed in-depth interviews based on a semi-structured interview guide, short-term participant observation and photos. This methodology has the advantage that it makes it possible for the subject to associate more freely than a questionnaire would allow. Photos serve to illustrate practice. The interviews and guided tours lasted some two hours – the shortest 1.25 hours, the longest about three hours. The number of visited households was set at seven – five women and two men plus two young people of 13 and 19.

The adults were selected by the following criteria:

Home: all were to live in houses

Distribution between urban and rural: two live in the provinces (Bella and Charlotte), four in the suburbs (Margit, Anne Margrethe, Janne, Ghita and Jan and the young) and one couple in the city (Ole and Mariann). All live on the Danish island of Zealand.

Distribution between owner and housing association: six live in their own homes, one in a housing association dwelling. This person was included to study the behaviour patterns of a person who was older and who has moved several times.

Life phases: age and activity level were used as a selection criterion. This decision was made because of the expectation that various activities in, and use of, the home in different phases of life could mean different 'use' of airing out.

Life phase	Interview partners
The young family	Three families (one with an asthmatic) Bella, Charlotte, Janne
Family with teenage children	Two families: (one with former asthmatic child) Ghita and Jan, Anne Margrethe
Couple or single with children no longer living at home	One couple and one single: Ole and Mariann, Margit

36°38′52′′ N
103°03′99″W
Trees-Clouds
Texline, Texas 2009
www.mitchdobrowner.com

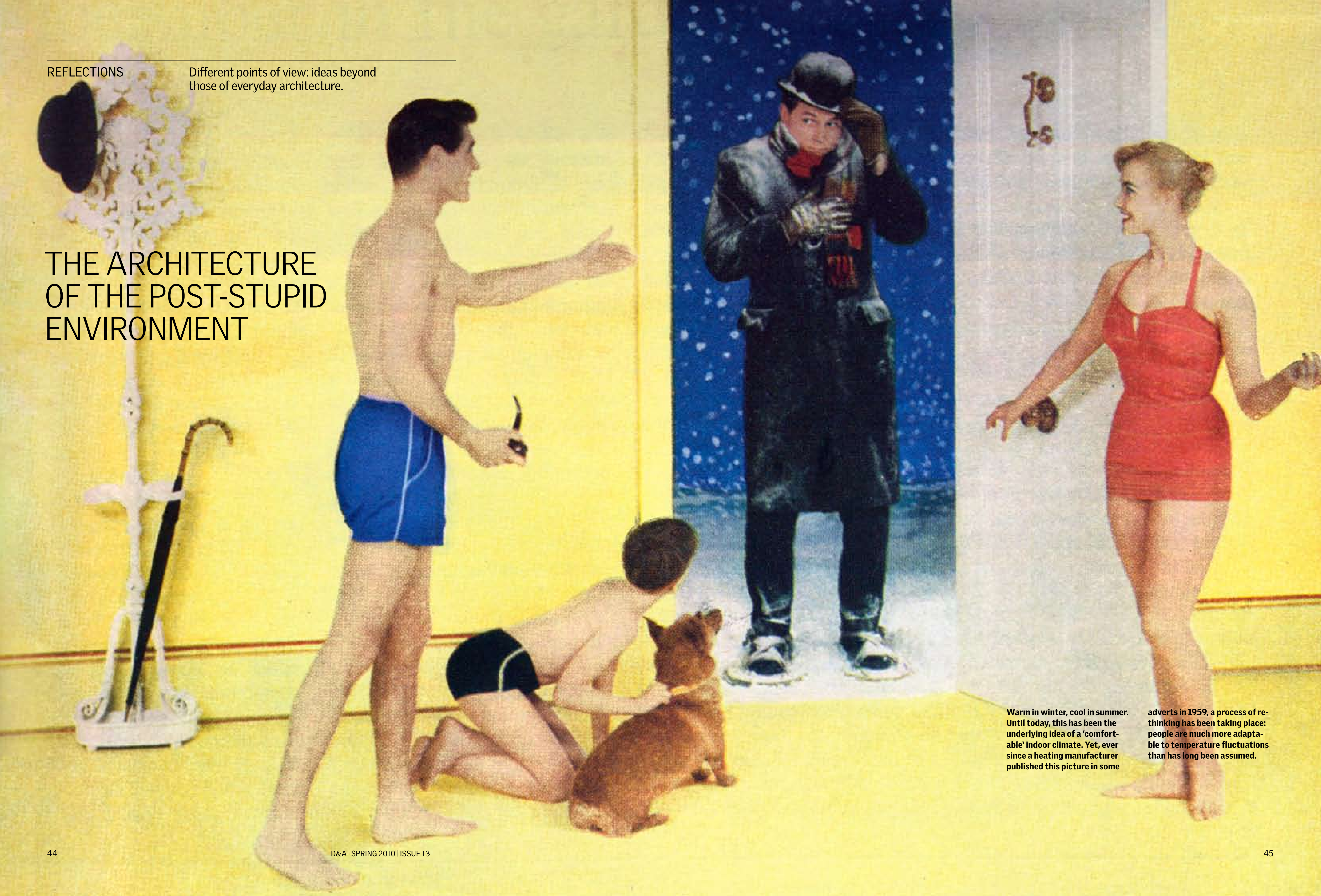
Mitch Dobrowner: Storms

"The Earth is an ever changing ecosystem. It's existed well before we were here,at times beautifully surreal, powerfully haunting and alive all at the same time.

While photographing, the world gets quiet around me ... things seem simple again – and I obtain a respect and reverence for the world that is hard to communicate through words. I get into a 'zone' where time and space seem hard to measure. For me those moments are a combination of the exterior environment and my interior combining. Hopefully the images presented help communicate what I visualize during those times."

ARM OF GOD, GALACIA, KANSAS 2009

MOTHERSHIP, OBAR, NEW MEXICO 2009



THE ARCHITECTURE OF THE POST-STUPID ENVIRONMENT

Warm in winter, cool in summer. Until today, this has been the underlying idea of a 'comfortable' indoor climate. Yet, ever since a heating manufacturer published this picture in some adverts in 1959, a process of re-thinking has been taking place: people are much more adaptable to temperature fluctuations than has long been assumed.

By Alan Powers

Left **"Licht Luft Öffnung" (Light Air Opening) – This book cover from Siegfried Giedion's "Befreites Wohnen" (Liberated Living, 1929) reflects a widespread philosophy of the 1920s. Daylight and fresh air was held by architects of classical modernism to be a means of preventing illness and generally improving well-being.**

The human body has a limited zone of tolerance between heat and cold, but fresh air is essential for comfort and health. Historically, the problems of reconciling temperature and ventilation have been addressed with ever more complex and energy-intensive technology. Only recently have calls for non-mechanical passive solutions, often more sophisticated versions of vernacular building techniques, become part of the mainstream of design.

WHAT WILL THE historians of the future, like the character played by Peter Postlethwaite in Franny Armstrong's film, *The Age of Stupid*, think of architecture and building in the age of fossil fuel? Have people been more stupid about these issues even than about travel or food production, the two other main sources of global warming emissions? The Modern Movement in the 1920s inherited late 19th century beliefs in the value of sunlight and oxygen but, in its focus on openness, failed to achieve adequate levels of comfort. Since the 1950s, the increased availability of cheap energy and power has allowed people in developed countries to feel entitled to wear summer clothes indoors in winter and to switch on air-conditioning and shut the windows in summer. In 1969, Reyner Banham published The Architecture of the Well-Tempered Environment, asking why the history of building services was so neglected compared to the history of style, but failed to spot the hidden history of passive climate control in architecture from vernacular to the Modern Movement. Banham had almost limitless faith in technology and in 1969 there were few professionals in architecture or building services to contradict him.

HEAT, COMFORT AND HEALTH

The baseline for domestic heating is the open fire in the room, which may take the form of a more thermally efficient stove and, in the next stage of development, heat introduced into the space from a more distant source, such as a boiler or air-warming device. As public buildings grew in size in the nineteenth century, new systems were pioneered owing to the impracticality of maintaining open fires. The Palace of Westminster in London, under construction in the 1840s, was a test-bed for some of these schemes. Systems of social improvement such as Victor Considérant's projected Phalanstère, 1840, included rational space heating that would be apparent as soon as a carriage entered the roofed courtyard. The idea of circulating heating and ventilation systems was applicable to domestic spaces but met general resistance for economic or cultural reasons, perhaps in part because they lacked the familiar aspects of user-control involving application of localised heat and air from open windows.

Knowledge of the composition of air followed on readily from ancient theories about the ill effects of moist or tainted air. Joseph Priestley's discovery of oxygen in 1774 was a necessary preliminary to a new understanding that the act of breathing needed to be supported by supplies of fresh air, and that 'vitiated air' must be removed. The English architect Henry Roberts proposed 535 cubic feet per person per hour (approximately 4.2 l/s per person) , and while he had no numerical calculation for daylight, he insisted on its necessity for health. An English book of 1874 raises the 'safe scale' for dwellings to 3,000 cubic feet (23.6 l/s), compared to 1,000 (7.9 l/s) per scholar for schools, and 2,500 (19.7 l/s) per horse in stables. The same author, William Eassie, records space standards per head for various building types, ranging from 240 cubic feet (6,85 m³) for metropolitan lodging houses to 3,500 (100 m³) in the new hospital (Hôtel de Dieu) in Paris. In 1911, the Encyclopaedia Britannica called for minima of 1,800 cubic feet of hourly air change for schools and 12,000 for a horse, suggesting that progress was measured in ever more ambitious figures. The British and French alike were suspicious of German or Russian stoves and the stuffy rooms that they were thought to encourage. With climates lacking the extremes of cold that these devices alone were able to render tolerable, they could afford their culturally conditioned inefficiencies.

By 1911, gaslight was beginning to give way to electric light but during its period of dominance, it was seen as a competitor for fresh air in a room, while the presence of an open fire and its chimney provided assurance of air movement. How were these air changes to be achieved? There needed to be inlets and outlets, coordinated in terms of the physics of air currents and the shape of the room. The open fire beloved of the English was liable in its efficient extraction of air to pull in high-speed draughts through the cracks of typically ill-fitting doors and windows, but the flow of air could be regulated by vents, such as the 'Sheringham Air Inlet', set into outside walls and controlled by a rope pulley. In a German book, Das Eigenheim des Mittelstandes, 1909, a system described as American is recommended for achieving the flow of pre-warmed and moistened air through a duct at sitting height with the use of extractor vents. Electric fans and cowls were used, but chiefly in public buildings. User interference has always been a weak point in otherwise mechanically perfect systems, however, and Britannica observed that


PHOTO: ©ARTUR/VIEW PETER COOK


PHOTO: ©ARTUR/VIEW EDMUND SUMMER


PHOTO: ©ARTUR/KLAUS FRAHM

people would close the vents on a cold day unless the incoming air was warmed. Furthermore, cold air was not necessarily fresh, unless the flow was working. If the incoming air was to be filtered through gauze and moistened by trays of water, these needed constant maintenance.

These ventilation issues can hardly be considered separately from heating, for which the range of options emerged during the course of the nineteenth century. Although America was in the lead, pressurised hot water heating was patented in London by an American, A. M. Perkins, in the 1830s and used by the architect Sir John Soane in his own house and museum. The American writer on domestic reform, Catherine Beecher, proposed an American Woman's Home in 1869 that abolished all open fires and replaced them with a basement furnace, closed 'Franklin stoves', and a hot water system running up through a central service core of the house. If not acted on immediately as a model, American houses were ahead of their European counterparts in thermal comfort, assisted by the widespread use of timber construction. The Victorian insistence on large volumes of internal air was displaced by the more rational concern for flow, allowing the development of the typical low-ceilinged rooms of the Arts and Crafts movement and Frank Lloyd Wright, who acknowledged the link between central heating and the open plan and also, in the Larkin Building, gave the nascent technique of air-conditioning a convincing architectural form.

Architects of the early 19th century, such as Soane and Charles Barry in England, seem to have taken heating and ventilation more seriously than their counterparts at the end of the century. In the years of rapid technological change around 1900, British architects were surprisingly resistant to innovations in other areas, such as steel and concrete construction. Britannica, looking expectantly towards an age of cheaper electricity, presents the summation of nineteenth century knowledge on heating and ventilation, both articles written by James Bartlett, a lecturer at King's College London and a member of the Society of Architects, but one wonders whether the small number of architecture students at King's College actually attended his courses. At the Ecole des Beaux Arts in Paris, these topics were beneath consideration, and could only be found at the Polytechnique.

In parallel with the accumulation of techniques and standards of warmth and air management, one would expect to find developments in window technology. The technical and performance standards achieved in the 17th century, whether in the form of English and Dutch sash windows or French casements, persisted into the nineteenth with little change, although cast iron presented the opportunity to reduce the visual weight of the glazing bar. For cultural reasons, the size of windows and their proportion to wall area remained unchanged or even diminished prior to modernism. Although the benefits of southern aspect were well understood, anxiety about excessive sun played a restraining role. The Mediterranean devices of external slatted shutters and internal blinds as a means of modifying solar gain were not commonly used in northern Europe, although verandas and external roller blinds (housed in wooden cases called lambrequins) were a notable feature of the first decades of the century.

In terms of regulating internal air quality, a window is judged by its air tightness. In Britain, where timber windows were notoriously ill fitting, steel, which became widely available in the 1920s from Crittall and other manufacturers, was viewed as an improvement, although it increased the condensation and heat escape associated with cold bridging. Thermal breaks and double glazing in Crittall windows became normal in the 1980s but why, one wonders, did it take so long?

The contradictory legacy of the modern movement

Frank Lloyd Wright is recognised as a stylistic precursor of Modernism, but Banham pointed out how his Prairie Houses not only integrated heating installations in the form of the building but provided solar shading in their deep overhangs, with windows well placed for air circulation for hot weather. This was a model for an eco-Modernism that appears to have gone into a long eclipse.

In Europe, the aesthetic demands of Modernism as an abstract style, grounded though they were in Wright's work, resulted in an unmethodical approach to climate conditioning in which passive heating and cooling were often put in a subsidiary place. The classic 1934 English book on *The Modern House* by F. R. S. Yorke claimed that walls 'may be of glass, metal asbestos composition, or slabs or sheets of some impervi-

Opposite page left Moggerhanger House (1791–1812) in Bedfordshire, Great Britain, is regarded as a key work of John Soane. Like his contemporary Charles Parry, Soane assigned enormous importance to the heating and ventilation of his buildings. In later generations of architects, his ideas were mostly forgotten.

Opposite page center At the IIT Crown Hall by Mies van der Rohe in Chicago, the trees were part of the indoor-climate concept. They provided shade to protect the rooms from overheating. When they were cut down in the 1970s, an air-conditioning system had to be installed in order to maintain the previously achieved level of indoor comfort.

Opposite page right Le Corbusier was hesitant to adopt the 'brise-soleil' concept, which was actually developed by Brazilian architects. The massive shadow-providing elements made of fair-faced concrete did not become a characterising element of his architecture until the post-war period, as shown here in the case of the Shodan House, in Ahmedabad, India (1956).

Right Indoor climate in the age of stupidity: apartment building in Japan with small air-conditioning units integrated into the facade.


PHOTO: FOTOLIA.COM

ous material; with a backing that will give thermal and sound insulation in little thickness.' With this belief, the benefits of thermal mass disappeared from view for a further 50 years, yet there was a wide variety of approach during this time. In The New eco-Architecture, Alternatives from the Modern Movement, 2002, Colin Porteous has made a good case that leading architects were more aware of the potential of passive climate control than we think, yet Le Corbusier's early experiments in *respiration exacte*, involving fully mechanical internal climate, went disastrously wrong at both ends of the climate spectrum and were exacerbated by the absence of opening windows. After he grudgingly adopted the brise-soleil (an idea developed by his colleagues in Brazil) in the 1930s, his applications of it were inconsistent in respect of appropriate orientation, while he ignored the unwanted effect of these concrete shades storing solar heat and radiating it back at night, when another material could have avoided the problem.

Much of today's understanding of passive systems probably derives from the period when European architects were building low-budget schools and universities in developing countries, but this knowledge was not deemed appropriate for developed countries. The oil crisis of 1973–4 provided a brief opportunity to take low-energy building further forward, but this was followed by the massive increase in oil use that one of the contributors to the film by Franny Armstrong, a former Texan oil man, so memorably described as 'The Age of Stupid.' Today everyone claims to be green, yet it is difficult to sift the genuine claims from the greenwash. In addition, there is less of a problem with new buildings than with the intelligent retrofitting of older ones, which is not yet seen as a glamorous creative activity.

Historians following in Porteous' path have a role to play in untangling the historical record and giving retrospective 'permission' from the Modern Movement masters to current and future architects to become green. The secret may not always lie in the actual buildings but in their surroundings, as with Mies van der Rohe's Crown Hall in Chicago, a fully-glazed structure that originally had only simple mechanical services. In the 1970s, air conditioning was installed, along with other piecemeal interventions that caused more problems than they solved. The clue was only discovered in a recent refurbishment by Gunny Harboe with Atelier One. Originally, Crown Hall had trees close to the building's south and west faces that provided solar shading in summer. It was when the trees died that the problems began – along with other sophisticated passive installations now incorporated in the building, the trees have been replanted.

The green credentials of interiors are now frequently measured in terms of the lowest possible air movement, achieved by a fanatical airtightness. The stage beyond this, as Porteous argued eight years ago, is for all buildings to engage with sunlight and daylight, 'but not to the exclusion of other major eco-indicators of architectural process and product.' Rather than replacing one form of stupidity with another, it seems that a complete solution can only be achieved by balancing all the complex factors that one hope will, in a short time, have become second nature.

Alan Powers is Professor of Architecture and Cultural History at the University of Greenwich and has published widely on British architecture of the mid-20th century, including the book Britain in the series Modern Architectures in History (Reaktion Books). He is chairman of The Twentieth Century Society, the leading British voluntary organisation for the protection of buildings after 1914.

THE INDOOR CLIMATE CHANGE

Precision is everything in the Centre for Indoor Environment and Energy of the DTU. The devices are therefore re-calibrated on a regular basis. Here is an anemometer for the measurement of slow air flows in a specially constructed wind tunnel.

By Christian Bundegaard
Photography by Rasmus Norlander

There is no point in saving energy, if it jeopardises the indoor climate. As wage costs exceed those of building energy consumption by a factor of about 100, the extra cost of modest increases in ventilation will be small compared to the increased productivity due to higher performance and fewer lost work days.

OUT HERE IN the control room you can hear somebody breathing inside the test chamber. The Ph.D. student running the experiment presses a button and the breathing gets heavier. Although it is far from the torture chamber of a sinister banana republic prison we are visiting, but the cosy workshop of the International Centre for Indoor Environment and Energy at The Technical University of Denmark (DTU), the whole thing is a tiny bit scary. Even indoor climate change is no light matter.

Peeking through the porthole, I realise that there is no real person inside the chamber, only a doll – or as the indoor climate experts call it, a "thermal mannequin". As Professor Bjarne W. Olesen, the director of the Centre explains, it is important to measure air velocity in the immediate vicinity of a person's body in order to tune the fine balance between ventilation and draught. The former is vital for a pleasant indoor climate, the latter is often the reason why office staff will hesitate to provide it by opening a window. Temperature and air flow are the two key factors in getting the right conditions. The thermal mannequin has to breathe, because even a person's breathing rate may affect the indoor climate.

During the last 40 years the Centre has become the leader of its field, attracting scholars from all over the world to participate in its interdisciplinary research. They come from Berkeley and Harvard Public School of Health in USA, from the Waseda University in Japan, Germany's Fraunhofer Institut für Bauphysik, and Tsinghua University in China.

It all began with the legendary Professor Fanger, whose groundbreaking work from the 1960s until his death in 2006 made him, and the centre he founded, world famous. Fanger was able to join together the complex interaction of the many different parameters in measuring thermal comfort: temperature conditions, air flow, activity level, people's dress etc., into a single framework. This scheme is still used by researchers in the field. Based in one of the unpretentious, three-storey buildings of the pleasant DTU campus in Lyngby north of Copenhagen, Fanger's successors, Bjarne W. Olesen and his team, provide us with a better understanding of the impact of indoor environment factors on human comfort, health and productivity. Thus an important research area is field and laboratory studies of these factors in private homes and office buildings, schools and other institutions.

But the Centre is also capable of more specialised studies. One of the test chambers has 24 aircraft seats. During experiments, test passengers are served genuine in-flight meals provided by SAS, can watch a movie and read or take a nap; in other words behave like real passengers during the 11-hour 'flight' that is going nowhere, but is very helpful in allowing aircraft manufacturers to study different cabin climate options.

In the controlled environment of another test chamber resembling a living room in a standard Danish house, a few wooden boards are connected to the Centre's gigantic tube system by several green and red hoses. These are the 'windows' of the test version living room – the changing temperature of real glass windows would be far too complicated to handle. As we walk through the test facilities, we pass several aluminium barrels the size of children and dressed up with electric wires. They seem to merge in with the students, who study indicators while taking notes on their clipboards. Bjarne W. Olesen smiles as he sees my bewilderment. "Some of the members of our artificial test crew," he explains. "We warm them up to 37°C and use them as stand-ins for real people in some experiments."

THE PROBLEM OF DAMPNESS AND THE MYTH OF DRY AIR

Standing in a heavily insulated and highly controlled steel box, where the ideal indoor climate conditions – and really nasty ones – can be obtained, I ask Professor Olesen what the main problems of the indoor climate are. Like most of us, I imagine that dry air must be the big issue. But here I am up for my first myth-busting surprise.

"On the contrary. But it is indeed a common misunderstanding. In fact, in most homes the air is too humid. A normal household with four people, two adults and two children, expires approximately 10–12 litres of water every day. It is a whole bucket of water they have to ventilate on a daily basis. That is one of the reasons why ventilation is so important for the indoor climate. You may even say that it is the most important measure to take in order to improve the quality of the indoor environment."

But then what about all the green pot plants we put in our offices, I try. "Well, I guess they look pretty," replies Bjarne W. Olesen with a smile. The same goes for the humidifier my

Previous spread **Other than in residential buildings, the air quality in the DTU's test laboratories has to be kept under control with a large amount of special equipment. This is the only way that the CO_2 content of the air, for example, can be held down to a fraction of one per cent exactly.**

Right **DTU researchers use ‚thermal mannequins', which can even breathe and cough, to carry out experiments on indoor air flows.**

mother used to hang on the radiators in an effort to fight the 'dry air' in my 1960s childhood home. In the dustbin with them! In fact, damp is such a problem in both private homes and schools that inadequate ventilation constitutes a major health risk. Living in too damp an environment you may develop asthma or respiratory diseases.

As ventilation seems to be the key to a pleasant and healthy indoor climate, one might wonder if the scientists could come up with a clear-cut definition of ventilation as opposed to draught. But that seems not to be possible. This is hard science only to a certain degree, and many of the crucial factors depend on so-called body perceptions – how each of us perceives thermal differences, air flow, odours and so on.

"Mind you, there is a lot of psychology in this, and the well-being of human beings is the final yardstick in all indoor climate research," Bjarne W. Olesen admits. "That is why we use so many resources paying test subjects to help us." The point with this is that insisting on what the thermometer shows does not help if you do not feel comfortable. Even if standards apply, people's opinions on what temperature is comfortable may differ in the range of 5–6 degrees. That makes it necessary for the researchers to rely heavily on questionnaires when they analyse a specific working environment.

This is an area in which the centre has done intensive research in recent years. Compared to former times, when a lot of people still laboured under harsh working conditions in mines or docks, most of us nowadays work in an office environment. That has moved the focus of the Centre's research from the dangers of different working conditions to comfort levels in offices. Or even the question of the effects of indoor climate on productivity.

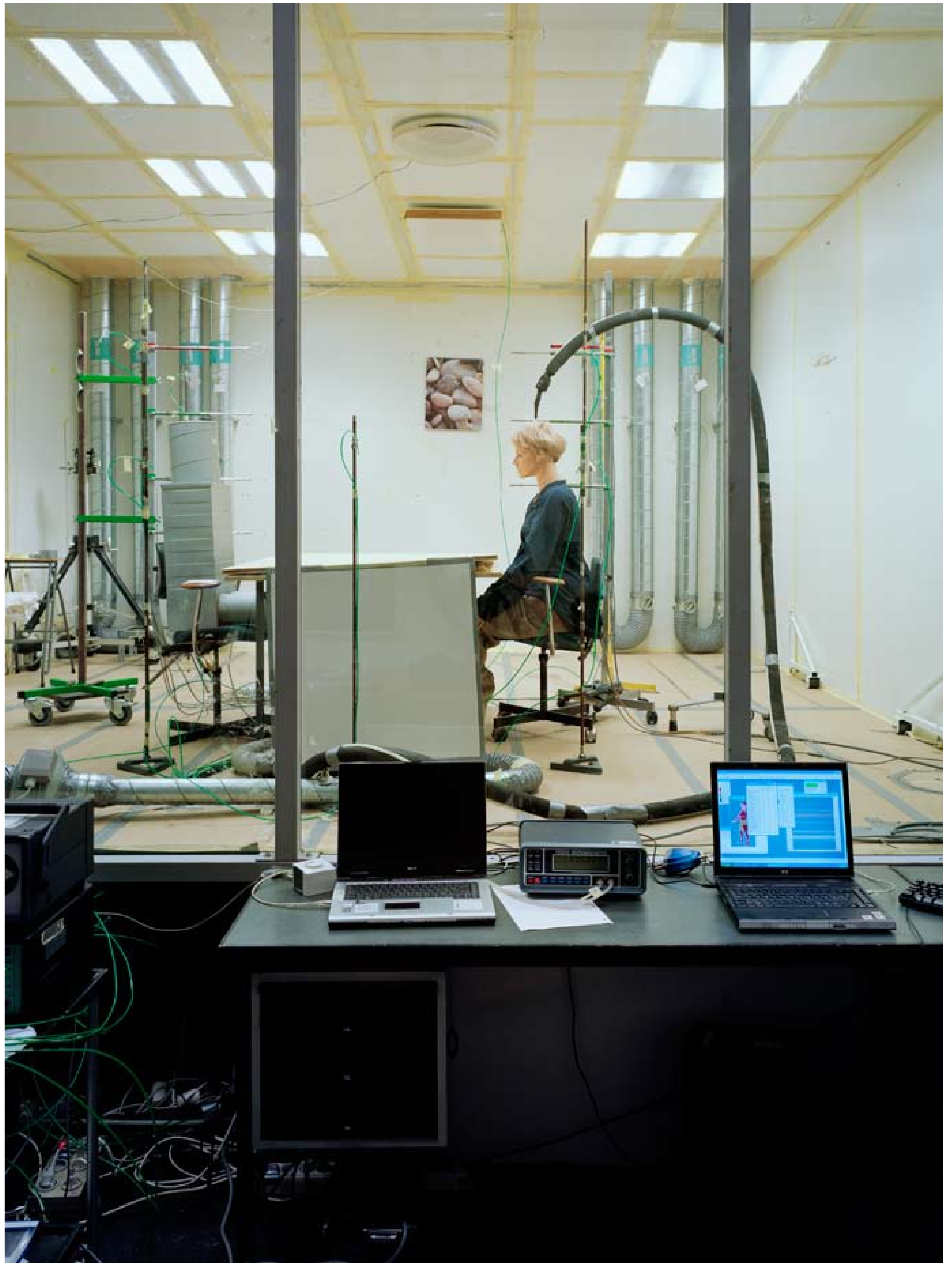
"We have done a lot of research on this over the years," says Bjarne W. Olesen. "And it all points to the same conclusion - that it would be devastating to ignore the indoor climate. If you do not feel comfortable because it is too hot or the air is polluted due to a lack of ventilation or contamination of the ventilation system filter, you may find it harder to concentrate; some will even get a headache or allergy symptoms, thus productivity is bound to decrease."

ENERGY EFFICIENCY VERSUS INDOOR CLIMATE: A NEW CONFLICT ON THE HORIZON?

But if air quality is important for the well-being of the staff, and thus for productivity, there may be a conflict between the increasing call for more energy-efficient buildings and the need for ventilation. As tighter building envelopes and high-efficiency windows make buildings more energy efficient, they also increase the need for adequate ventilation to compensate for the air that gets into buildings through cracks and small holes. Without increased ventilation, pertinent initiatives to mitigate the climate change through energy-saving measures may result in a deterioration of the indoor climate. And when Bjarne W. Olesen approached the hostess of the Climate Change Conference Copenhagen 2009, the then Danish Minister for Climate and Energy, now EU Commissioner, Connie Hedegaard, and proposed a section on the indoor climate issue, he was turned down. In spite of this, he is still optimistic.

"There is a lot of focus on the outdoor climate and the energy question, and in this situation our field tends to be a bit neglected. But we try to communicate that there is no point in saving energy if it jeopardises the indoor climate. As wage costs exceed those of building energy consumption by a factor of about 100, the extra cost of modest increases in ventilation will be small compared to the increased productivity of perhaps 10–15 percent due to higher performance and fewer lost work days. That does not mean that we should not make buildings more energy efficient, but that it is also important to make a simple calculation like this."

If the climate inside our office buildings seems to have been forgotten, the situation is even worse in schools. Recent field intervention experiments in elementary schools in Denmark have shown that the fresh air supply is far below the recommended level in many cases. As a poor indoor environmental quality in office buildings can reduce adult's productivity, it is reasonable to suspect that a poor climate can also negatively affect the performance of children's ability to work in the classroom. Air quality is assessed through CO_2 measurement. In many countries that have applied air quality standards for schools for example, the level of CO_2 should not exceed 1,000 ppm (parts per million). The above-



The average human being spends more than half of his time at home in bed. With the help of thermal mannequins, the parameters of thermal comfort can be investigated for such situations as well.

mentioned field intervention done by the International Centre for Indoor Environment and Energy indicated CO_2 levels in excess of 4,000 ppm.

"From the research we have done on this," Bjarne W. Olesen says, "we must conclude that by providing better ventilation, performance would increase by the same degree as in offices, that is 10–15 percent. That is a whole year during a seven year period. Which means that you can leave school after six years instead of seven," he laughs.

He is quite adamant, however, that the way to secure a better indoor climate in offices as well as in schools and private homes is through regulations. That is why he spends a lot of time taking part in EU deliberations on a revision of the energy certificate that sets various demands on the energy efficiency of buildings.

"We hope to add a few lines on indoor climate to the text. Some countries – Portugal for example – have already written the indoor environment into the wording of their certificate. This is a lot of work, and it will take some time to succeed, but I believe this is the way forward. Looking back, we would never have made the progress on energy efficiency or sustainability without political involvement and the introduction of regulations. For us, it is a good way of making use of our research."

In fact, it is astonishing that a vital substance like the air we breathe is less controlled than many other aspects of our daily life. As Bjarne W. Olesen says, "You can make the comparison with the way we treat food. Every tiny item in the supermarket cooler must be labelled with product information. But you 'eat' 15 kilos of air every day without no product declaration at all."

Christian Bundegaard is a freelance writer based in Copenhagen. A former Head of Communications at 3XN Architects, Assistant Editor at Danmarks Radio (Danish Broadcasting Corporation) and Literary Director of Gyldendal Publishing, he is also the author of several books, articles and radio features on a diverse range of subjects, including architecture, design and urbanism.

Children and indoor climate

In an ongoing investigation conducted by The International Centre for Indoor Environment and Energy together with Odense University Hospital, researchers are studying the homes and day-care facilities of 500 small children in the city of Odense in the south of Denmark.

Recent research has revealed that the risk of developing asthma and allergy increases when children are exposed to plasticisers. It has been found that there is a greater incidence of allergic diseases in children from homes with a high concentration of plasticisers in domestic dust.

"We have already done some studies in Sweden and Bulgaria, and we are now taking a closer look at Danish day-care facilities," says Associate Professor Geo Clausen, who is heading the project. "This project is part of a general interest in the recent explosive growth in the number of children with asthma, allergies and building-related illnesses. Our interest is directed towards air quality because there is scientific evidence of a link between volatile organic compounds and health."

The interdisciplinary research project is made possible by a donation of DKK 7 million. (€ 940,000) from the Villum Kann Rasmussen Foundation.

"ARCHITECTURE IS THERE TO REVEAL THE FORCE OF DAYLIGHT"

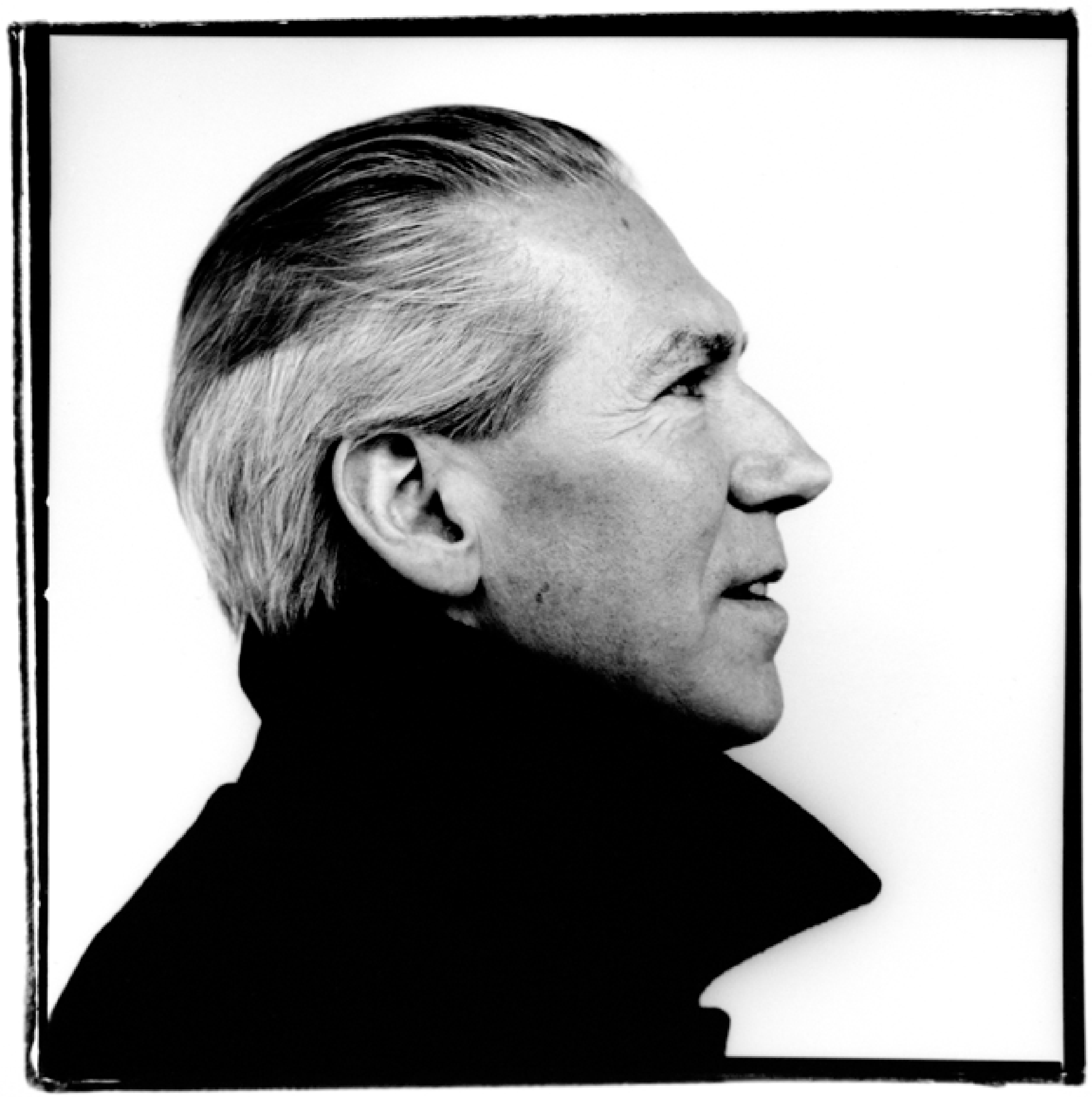


PHOTO: MORTEN KROGVOLD

Interview with James Carpenter
By Brian Woodward

For the American architect and artist James Carpenter, daylight is an essential means to improving the quality of interior and urban spaces – and thus improving the quality of life of human beings. This spring, Carpenter was awarded the Building Component Award by the VILLUM and VELUX Foundations for his work related to daylight. In an exclusive interview with Daylight & Architecture, Brian Woodward spoke to the New York-based artist about his latest works, the notion of 'volumetric light' and its implication on the future development of buildings and windows.

If Paris is the city of light, then Manhattan might be called be the borough of daylight. At least according to 59-year-old James Carpenter, the hard-to-categorize daylight artist, architect, sculptor, glass expert, lecturer and idea man who has called the island home for most of the past 40 years. Today, Manhattan is also a gallery for many of Carpenter's most spectacular works. "We have incredible qualities of light here in Manhattan," Carpenter explains, "because we are surrounded by water and we have a lot of sunshine each year. That may not always be apparent to people on street level until they step outside the city; until they stand on the Brooklyn Bridge and can see the interaction between the light and the landscape from afar." Carpenter has been honoured this year with the Daylight and Building Component Award for his lifelong accomplishments in daylighting design. He will receive the award, and the €100,000 prize that goes with it, at a ceremony on March 2 in Copenhagen.

Most of Carpenter's works are large scale: the podium wall at the new 7 World Trade Center, his Dichroic Light Field on the facade of the Millennium Tower or his Ice Falls in Hearst Tower. Architects like Norman Foster, Richard Meier and David Childs call upon Carpenter's JCDA studio when they face particularly difficult daylighting challenges. "What Jamie brought to 7 World Trade Center was another point of view – one that doesn't necessarily think pragmatically about building but rather that looks at how certain materials and technologies can be employed to create a different experience," says T.J. Gottesdiener, Managing Partner on the 7 World Trade Project for the design architect Skidmore, Owings and Merrill. "Jamie has become a part of the profession now but what he has always contributed was an artist's perspective."

Seen as a whole, Carpenter's projects can be described as an ongoing attempt to reflect the natural world in built environments. And here, Carpenter says, daylight is as essential to building as a bricks and mortar. I talked to Carpenter recently as he was in the middle of a tour of lecturing and visiting project partners in Europe. I asked him to talk about the big idea that is driving him now and whether his ideas about light could one day be brought into the lives and homes of ordinary people.

BW You've won a substantial prize, but can daylight truly be called a building component?

JC I believe there are two ways of looking at daylight. The first is more traditional and in this view architecture relies on daylight to reveal its forms. In this way, you could say that daylight is in the service of architecture; it is used to enhance the architecture.
The second is based on the idea that daylight is essentially environmental information and here architecture can help to reveal the deeper complexity of daylight. Architecture is there to reveal the force of the daylight. I subscribe to this second view.

"The key to the successful project's development is focused experimentation", is how James Carpenter describes the way he goes about his work. His New York office James Carpenter Design Associates (JCDA) made a name for itself through experimental work with glass and light.

Left **The fact that a window can be more than just a glazed opening was demonstrated by James Carpenter with his 'Periscope Window' in a house in Minneapolis (1995–1997). A system consisting of mirrors and lenses projects sunlight onto an interior frosted-glass panel. A direct view of the outside would have been much more boring in this case: the wall of the neighbouring house is only a few metres away from the window.**

Right **In the atrium of the Hearst Tower in New York (architects: Foster and Partners), James Carpenter Design Associates created the "Ice Falls" project. Prisms made of cast glass form a staircase-like construction over which water flows. On sunny days, the interplay of glass and water generate countless reflections and refractions of light.**

BW You work a lot with skyscrapers and massive urban structures, how can they reveal the force of daylight?

JC Light in the urban environment is especially complex because of the way it is influenced by adjacent buildings and structures and environmental factors. That was the case with 7 World Trade.

Something I am very focused on is the concept of volumetric light or the idea that light is not falling on a single plane but that there is the ability to create various qualities of light simultaneously. Think of what we see in nature, for instance. You can actually see the volume of light in a cloud or in the ocean or even on the leaf of a tree. Light takes on the quality of a solid, even though it is not a solid. It seems to have a physical presence and a volume to it. That can be created by capturing light being transmitted off of various structures simultaneously.

BW You mentioned 7 World Trade, which is remarkable both for its environmental qualities (it was the first LEED certified skyscraper in the US) and its security considerations. From a design standpoint, what do you think is most remarkable?

JC The building has a depth of light, a volume that is created by both the outer and the inner surface working together so that we have the impression that the building is constantly playing with light. The building is really a recording of the dynamics around us. Its skin is meant to mirror the conditions of the sky and daylight over Manhattan and I believe this is the feature that most people find remarkable. We did this by using curved steel spandrels and polished reflective sills. It works because daylight is reflected off the spandrels and onto the large sheets of glass that make up the skin of the building and because the glass contains almost no iron, the skin of the structure is exceptionally clear and can capture the color of the sky and natural light around it exactly as it is.

BW What about the podium wall that you designed at the base of the building?

JC The reason that the building had to be constructed so quickly in the first place was that there is a power substation in the basement that serves much of lower Manhattan and so it had to get up and running as soon as possible. This building had to go up fast and that was a requirement from not only the developer but the authorities. The substation extends 82 feet up from ground level and it turned out to be one of the biggest challenges in the project.

The problem was that the base, the power substation itself, was a solid concrete vault. David [ed: architect David Childs of SOM, design architects for the overall project] wanted us to get involved with how you might conceptualize a building that would unite the two very different concepts of a concrete vault and interaction with the external environment.

The concept we arrived at was creating a volumetric skin, so that the building can play with light on two different surfaces – both the inner and the outer. And once we had figured out how to do that, we also figured out how to make what was originally a huge concrete vault interact with its environment.

BW How did you do that?

JC There are two ways, depending on daytime and night-time. During daylight hours, we created the volumetric effect by wrapping the vault in two layers of stainless steel screen panels with a small cavity between them, which was needed to meet the ventilation requirements for the electrical transformers. The panels are made of vertically oriented triangular wires welded in a specific pattern and the front screen wires are highly polished while the back wires are plastered with glass beading. During the day, the outer layer of the triangular wire reflects light according to the wires' orientation and any light that penetrates the outer layer is diffused by the back layer's bead-blasted surface.

At dusk and again at dawn, LED lights are used to illuminate the back screen of the wall and give the impression that the entire substation vault is a glowing, cobalt blue. This unites the podium wall with the glass curtain wall of the tower.

We also mounted cameras on the building that are tied into a software system that can read pedestrian movements and then transform them into 80-foot-high verti-

Grids made of triangular stainless-steel rods lend structure to the panels on the base of 7 World Trade Center. Like the entire building envelope, this facade also consists of two layers.

7 World Trade Center, the first completed new building at Ground Zero after the terrorist attack of 2001, was Carpenter's biggest project to date. The double glass facade that James Carpenter developed jointly with architect's office SOM makes the office building seem to merge with the blue of the sky.

At night as well, the base of 7 World Trade Center also unfolds its effect. Blue LEDs result in a kind of light artefact, in front of which the stainless-steel grids look like much more than just a structured composition of lines.

cal bars of light within the podium skin, so that when someone walks by, these bars of light follow them. The idea is that the light will eventually engage the cultural life that develops around the building and personalize the urban experience for everyone.

BW How can we integrate or adapt your thoughts about light on a residential scale? Is that even possible?

JC There is no question people are spending more and more time indoors these days, and that creates the need to bring more light into residential situations. Perception of light is something we do not develop enough in residential design.

Typically we think of light as something that strikes a single surface and then that surface reflects the light back to the eye. If you begin to think about volumetric light, though – that is, where the same light strikes one surface and then perhaps a diffused surface, perhaps a reflective surface and then another diffused surface – then you actually use the same light source to reveal itself in multiple ways on multiple surfaces. This creates the perception of greater amounts, depth and richness of light. The concept can be used to help distribute and give different perception of light's qualities indoors. So that is one way.

The other way I see this happening, and it is something we are concerned with, is to think more creatively about the notion of what the window is. Our perspective is that there is an opportunity to use very simple optical systems ideas and have them discreetly integrated into a window system. Using reflectivity and lenses or mirrors can give what we think of as a window today, the ability to gather a higher amount of daylight. This means, effectively, that the window sees more sky brightness and that brightness is then transmitted or brought into the building through various types of reflectors or various types of finishes on the glass that perceptually make you feel like there is more light available in the environment.

BW So you are talking about creating illusions? About looking at a window instead of through it?

JC Well, you could say that – but, again it is really about changing the way we think about what a window is and using it to not only solve design challenges but to open up entirely new design opportunities.

Our Dayton Window project is a great example. This was a situation in a private residence where there was a need to have daylight in the house, but two meters from the side of the house was another building and the view was totally obstructed by its wall. If there we had used a traditional clear glass window, and it was a large, 3×5 meter window, there would have been absolutely no view and it was dark.

By using a series of mirrors and simple lenses and a large sheet of diffused glass, we basically created a type of periscope where when you look perpendicularly or horizontally across the space at the window, the view you see is in fact the view you would otherwise get by looking straight up in the sky. Using mirrors brings the view of the sky down into the window plane and then, through a series of lenses and diffused glass, it reconstructs the view of the sky.

When you look at that window today, you think that there is uninterrupted depth. There is a great deal of brightness and visual information in terms of view that is brought into that window that is otherwise not there, so it is basically a way of reinvestigating very simple optical principles and then applying them to very conventional systems so they become something that is more dynamic and more active relative to their ability to gather and display qualities of light.

BW Is that a solution that is accessible to the general public? Will it ever be?

JC I think these things can definitely be done very cost effectively, it is simply a matter of using qualities of reflectivity, diffusion and brightness through optics and that could be done with very inexpensive materials. Metals, plastics or very simple materials could be very easily integrated into existing window systems; it would just be a matter of working conscientiously with a company to develop those ideas as a new product.

BW Can your ideas about residential building be linked to sustainable thinking?

JC Absolutely. We now understand that sustainability and conservation of resources is basically driven by density and that urban densification is one of the big challenges for the future.

One obvious way they are linked is in how we can minimize utilization of artificial light. If you can maximize the use of daylight and create systems that productively project and utilize daylight, those same systems could be activated by very low levels of artificial light and be able to take small amounts of electric light and distribute it over large areas.

Again, it is this idea of playing with the perception of light. And it is not limited to windows – on the exteriors of buildings it would operate the same way. In the evening you could very easily have exterior lighting using much lower levels of light if we actually used building surfaces and perhaps even the paving surfaces as very discreet reflectors so that buildings are activated as a light source themselves.

Then there is the question of thermal performance. Windows have become extremely efficient but I just think there are still opportunities to make them efficient in different ways, not just in terms of thermal performance but also in terms of optical performance. And without one compromising the other. We definitely have the technology today to improve those systems, maximize daylight availability and maximize the conservation of heat gain that occurs in a building itself.

BW You mentioned urbanization. How do we ensure daylight is available in the homes of future city dwellers?

JC There is no question that if you are speaking of any urban context, there is very little thinking or regard being given to daylight. The need to investigate ways of both internalizing and bringing into the residential realm qualities of daylight and qualities of the phenomenon of light is important.

Light is the medium through which other visual information is brought to us. I mean, shadows, projection of image, images of landscape or whatever it may be - obviously light is always a component of that information transmission.

Using light to create a different reality from what is actually outside the building is one of the things I am quite interested in. The window does not have to have a direct correlation to what is immediately outside it. There is a way to construct a view, and the perception of a different reality that exists outside the window, by using these ideas of periscopes and lenses. I think the key to connecting to nature in the built- residential environment is views or the way shadows and imagery can be actively brought into a living or workspace.

Think of all the dark apartments and row houses in all the cities of the world that could benefit from this. And there will only be more of them in the future.

James Carpenter, 59, artist, architect and materials expert, is the winner of the 2010 Daylight and Building Component Award given by the VILLUM and VELUX Foundations. Carpenter received the award, and a grant of €100,000, for his contribution to the understanding, knowledge and interest in daylighting at a ceremony in early March in Copenhagen.

Carpenter is founder of James Carpenter Design Associates (JCDA) based in New York City. Throughout his career, he has worked collaboratively with pre-eminent architects and engineers in the United States and abroad including Norman Foster, Richard Meier (SOM), and Michael Van Valkenburgh on creating the artistic complement to many significant buildings.

THE HOUSE THAT GIVES MORE THAN IT TAKES

"We are not particularly idealistic or green but we are influenced by the current debate on reducing CO_2-emissions", explains Sophie Simonsen. "So when we were given the offer to move here, we thought it was a marvellous opportunity to do something worthwhile. Here we are part of the future and I hope that, in the long term, it will inspire our children."

By Jakob Schoof
Photography by Adam Mørk and Morten Fauerby

Home for Life in Lystrup near Århus, Denmark, is a new CO_2-neutral, one-family house with a special focus on indoor climate. It was built as the first of six experimental houses in the VELUX Model Home 2020 project. Currently, the Simonsens – a family of five – are experiencing and testing the experiment to find out whether the house allows the sun to power their lives and whether it gives more than it takes in the long run.

Previous spread **'Home for Life' at twilight. The open indoor layout of the house is visible even from the garden. Nearly all the rooms receive daylight; from a living room one and a half storeys high, it is possible to look outside in all four directions of the compass.**

Left **Many details in 'Home for Life' have the goal of maximum possible transparency: it is possible to look through the staircase towards the entrance to the building while the partition walls on the upper floor are partially glazed in order to let daylight in.**

The way in which buildings are planned and constructed is changing rapidly. While global climate change may be the most important driver in this development, the challenge is not confined to energy issues alone. According to a World Health Organization report, 30% of all new buildings worldwide have varying degrees of deficient indoor climate. Can we do better than this? Can we create buildings that contribute positively both to global climate and to human well-being?

"One experiment is better than a thousand expert views," VELUX founder Villum Kann Rasmussen once said. In line with this principle, VELUX has initiated the Model Home 2020 project, six experimental buildings that combine several objectives: to consider energy use in buildings in a holistic perspective; to create an efficient building envelope with technology and design; and, at the same time, to achieve the highest standards of indoor comfort and health for the user.

More information on the experiments is available at www.velux.com/model-home2020

Home for Life, the first building to be completed as part of Model Home 2020, is the result of an interdisciplinary design process concentrated on three main parameters: energy, comfort and visual appeal. All three parameters should complement each other and, by so doing, maximise the quality of life in the home and the world around it. The project set out to focus on the use of renewable energy in buildings at the same time as creating optimal user comfort by utilising daylight and giving the user active control of light, air and temperature.

The Simonsen family from Lystrup, north of Århus, are currently trying to find out what living in this kind of building really feels like. In summer 2009, they left their conventional '70s bungalow to move into Home for Life. For one year, they are testing the living environment, which, in certain ways, functions differently from what they are used to.

"We are not particularly idealistic or green but we are influenced by the current debate on reducing CO_2-emissions," explains Sophie Simonsen. "So when we were given the offer to move here, we thought it was a marvellous opportunity to do something worthwhile. Here we are part of the future and I hope that, in the long term, it will inspire our children."

Rooms with a view – and plenty of daylight

Home for Life, which stands on a suburban lot in Lystrup, represents in many ways the aspirations of homeowners in the early 21st century. It is home to a family of five, with a large, undivided living space on the ground floor and individual rooms above. This spatial concept enables each family member both to spend time with the others and to withdraw from the group if needed.

The design of the house ensures that all rooms enjoy unobstructed views onto the surrounding countryside. Most rooms receive daylight from at least two directions. The positive effects of this strategy on the inhabitants' well-being are obvious: when the sun strikes one of the facades of Home for Life on a hot summer's day, the solar screens on this facade will go down, but the rooms behind it still receive glare-free, indirect daylight from the other side, which both improves visual comfort and means the electric lights do not have to be switched on.

Sverre Simonsen is very enthusiastic about the outcome of this strategy: "The most noticeable difference is the light. The light that comes in is fantastic! We're flooded with it and on days when we would have several lamps switched on in our old house, here we need none – every room gets daylight from at least two directions. The house has an amazing panoramic view – and in the utility room especially, the countryside feels like it's part of the house because the slate floor continues out to the terrace."

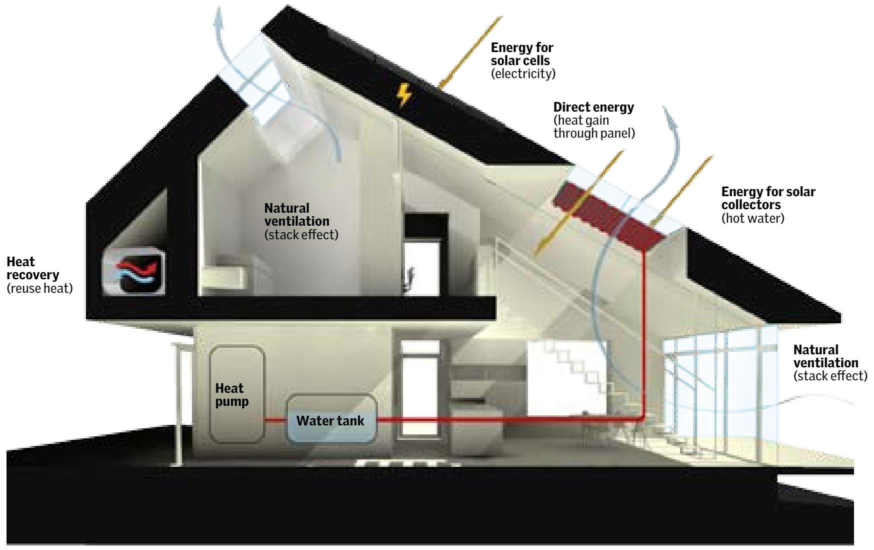
On the ground floor, the living space with the open kitchen area even has windows on (and views out to) all four sides. Here, the borders between inside and outside are dissolved as far as possible. Many windows and patio doors reach to the floor, which makes the room appear larger and more airy, while roof windows placed high up bring daylight deep into the space.

"With Home for Life, we pursued three main goals – energy, comfort and aesthetics – which should all have an equal priority. Regarding the indoor climate, we put special emphasis both on daylight and natural ventilation, which is why the building has quite a lot of windows. We wanted to get daylight from at least two directions into all bedrooms and living spaces. This made a lot of thinking necessary, but in the end proved well worth the effort.

In summer, the house operates entirely on natural ventilation, which ensures a good indoor climate and helps save energy since no ventilators are needed. The key to ensuring the necessary airflow indoors was placing the roof windows high up in the rooms. This creates a natural chimney effect but prevents drafts, which can otherwise be a nuisance to the inhabitants."

Amdi Worm, Esbensen Consulting Engineers

Right **Conceptual section of the building. The transverse ventilation profits from the chimney effect that arises in the high, open living room. Air flows in through the terrace windows into the building, where it becomes warmer and then flows out again through the roof windows.**



"The family experiences that they use less artificial lighting than they did in their old house. According to Sverre, this is partly because there are not as many lamps in the house, but mostly because of the abundance of natural light, which the family enjoys and mentions as a very positive element in the house; a comfort factor sometimes conflicting with the automated sun screening – 'what is remarkable about the house is the masses of daylight, and I do want that'."

Extract from interviews by Johanne Mose Entwistle, Alexandra Institute

Simple but intelligent: the indoor climate concept

The design is focused on energy and contemporary aesthetics but based on common sense and use of low-tech solutions wherever possible. Around 50% of the annual heating needs of the house is met by passive solar gains through the energy-optimised windows. All windows have both external blinds that provide shade when necessary, and interior sun screens that prevent glare during the day and heat loss at night. The windows are also a key factor to the ventilation: they provide fresh air - especially in summer, when they replace the mechanical ventilation system altogether. The key to this is strategic window placement. Roof windows were placed high up in the rooms to let warm exhaust air escape easily. This creates a natural chimney effect inside the rooms, which draws fresh air in through the lower facade windows.

Many components of the house, especially of the facades, are automatically controlled by an intelligent building operation system but can be manually overridden by remote control. Windows open and close automatically, depending on CO_2 levels and room temperatures. At night, windows and blinds are closed automatically to avoid heat loss, but during the day the exterior and interior shading elements are also operated automatically to prevent overheating. Movement sensors turn the lighting on and off to avoid excessive electricity use.

Living in an experiment and monitoring the outcome

Home for Life is being scientifically monitored (to maximise experience and knowledge-sharing) by a team from the Engineering College of Århus, the Alexandra Institute, VELFAC and Window Master. Engineers and anthropologists are studying how the Simonsens interact with their new home, especially with the intelligent building operation system that controls the heating, lighting, ventilation and sun screening. They also measure the actual energy use and energy production of the house as well as numerous indoor climate factors such as light levels, air temperature, CO_2 concentration and humidity. At the same time, outdoor environmental factors such as solar intensity, air temperature, humidity and wind speed are constantly measured to assess their influence on energy balance and indoor climate.

First results

Data on the house's energy production, energy consumption, temperature and CO_2 for the first six months have now been collected. During this time, the house was continuously adjusted to perform according to the family´s needs and well-being. The highest priority was to ensure the framework for family life, with the corresponding data on energy consumption and other figures coming further down the list. Home for Life features new products, new technologies and several prototypes that were used here for the first time and in a unique constellation. This is an important aspect of the experiment and reflects the aim to gain knowledge by testing theories, as well as to gain and share experience through innovation. No conclusions are made at this point, but some important lessons have been learned during the monitoring phase.

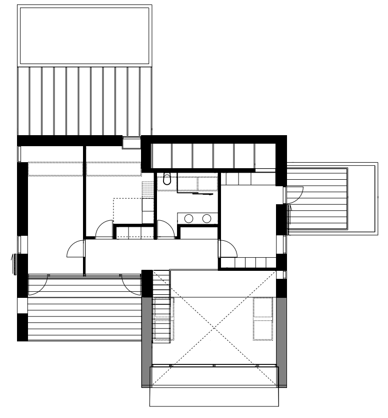
Components and technologies need time and effort to fine-tune configuration and optimisation, as well as adaptation to the family´s needs. In the first months of operation, a high level of automation in buildings is particularly demanding in terms of adjustment and tracing possible sources of error.

Room heating has presented challenges, partly due to the unique overall concept and partly to the use of the house. One example is the pre-set night temperature, which was raised when the new little sister arrived, as essential activities also take place in the house at night and require the same set temperature as during daytime. On one occasion, the district heating in the area shut down but the Simonsens kept warm thanks to the self-sufficient energy concept of the house. When electric power failed once, however, they discovered just how much they depended on electricity for controls. The change from natural ventilation to mechanical ventilation (winter situation) was experienced as a lack of fresh air.

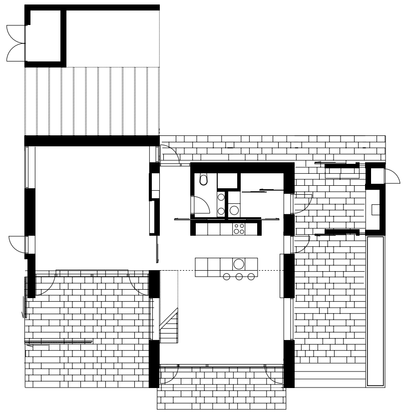
The Simonsens observed an abundance of daylight, which led to a lower use of electricity. The monitoring will continue for the next two seasons and focus on the difference in performance between natural and mechanical ventilation, on further programming and configuration of the control systems, on the behaviour, preferences and experiences of the family as well as on how the benchmarks for the energy and climate performance that were initially calculated during the design phase compare to the actual performance during operation.

Some of the Simonsens suffer from allergies, hay fever and respiratory problems, so everyone is looking forward to seeing whether the indoor climate and the choice of materials in the house will alleviate these problems. "We are excited to see whether the good ventilation and correct materials play a role and whether we will see a general improvement in our health and well-being. We need to go through a pollen season before we can arrive at a valid opinion. But we did notice from the very first night that the air in the house is good. The rooms are comfortable all the time because the warm air is ventilated and you can adjust the indoor climate to suit the air outside," says Sverre Simonsen.

Sverre and Sophie follow the screen information on energy production and consumption with great interest, and it is important for the family to try to meet the performance target of the project. It gives them great joy when they see that the house produces energy and that their own energy consumption has fallen. "On Sunday it was evident when the sun came out. I just had to take a look: does this really influence production? Yes! It does! That was a real ´yippee!' experience! It is actually really good fun and wonderful, just wonderful [...]. These small experiences: yes, they make a difference, there is something in our house producing, there is some sense to all this. It is giving back, it's great!"



First floor plan



Ground floor plan

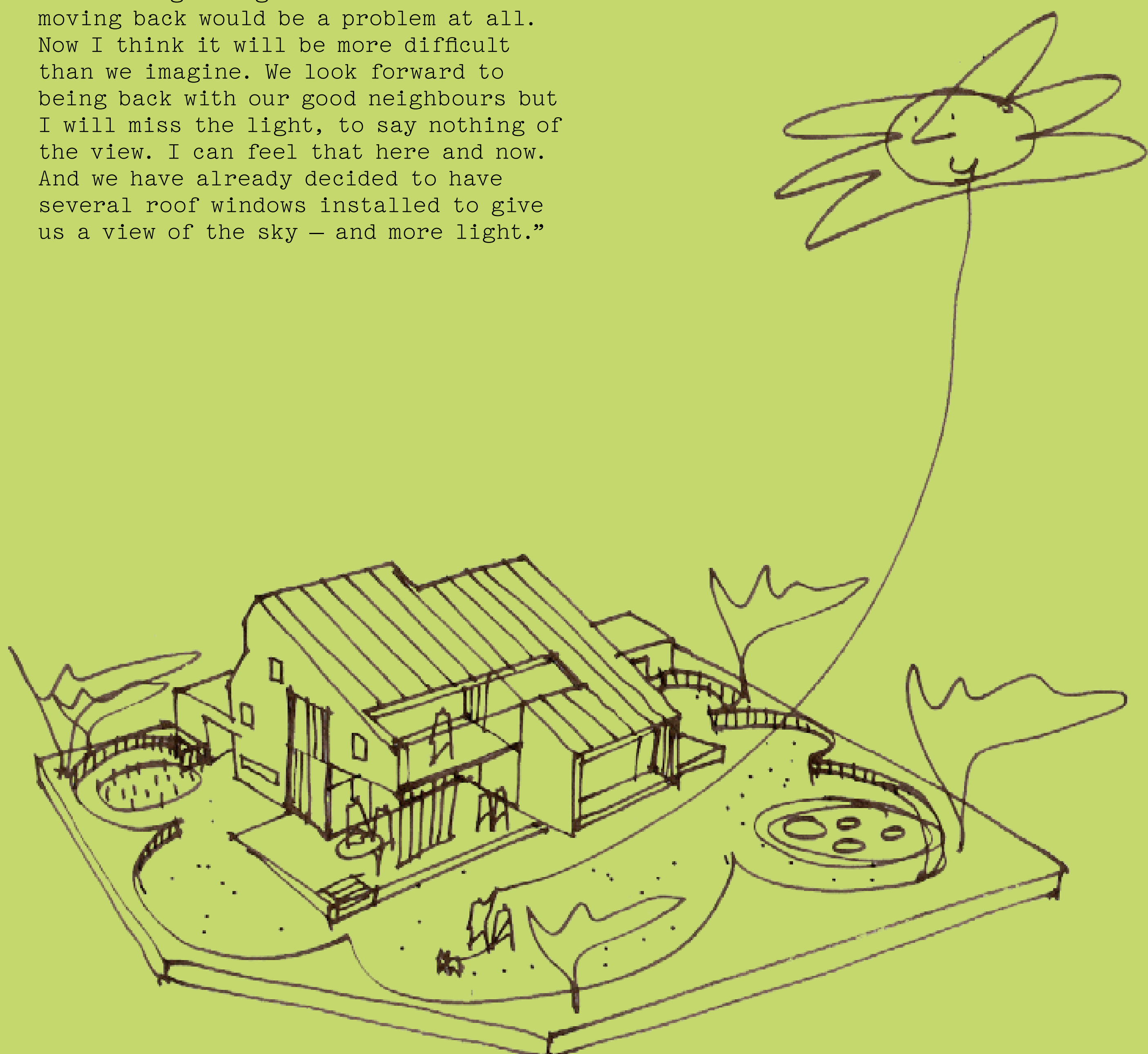
Facts

Partners:	VELFAC and VELUX
Architects:	aart, Århus, DK
Energy concept:	Esbensen Rådgivende Ingeniører, Århus, DK
Turn-key contractor:	KFS Boligbyg, Støvring, DK

DIARY

In an online diary, the Simonsens describe how they have experienced their new home and its interior climate so far. Here is an extract of their account:

"In the beginning I didn't think moving back would be a problem at all. Now I think it will be more difficult than we imagine. We look forward to being back with our good neighbours but I will miss the light, to say nothing of the view. I can feel that here and now. And we have already decided to have several roof windows installed to give us a view of the sky – and more light."



August 10, 2009

PHOTO:

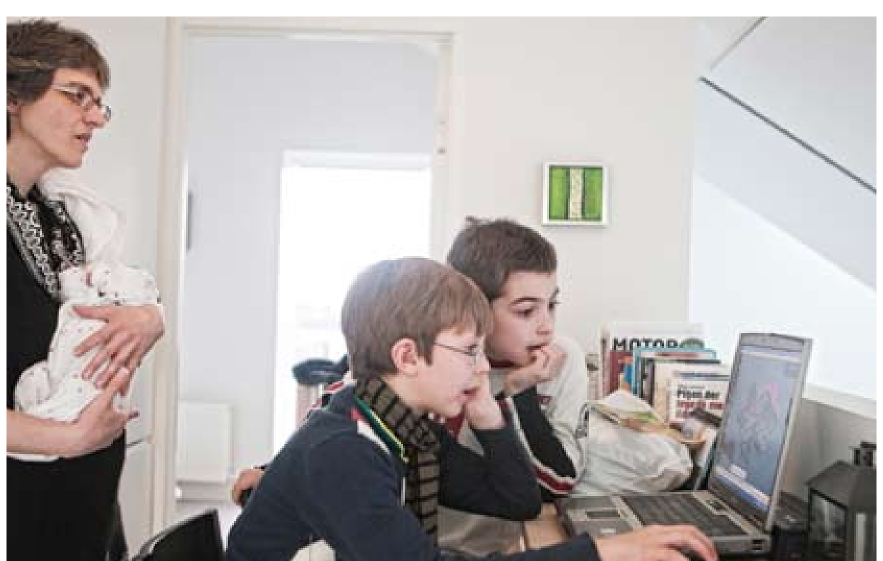
Indoor climate
In the first days we noticed that the air was fresh and good. We sleep well at night, better than in our old house. In the first days of July there was a heat wave (27-28°C) but the house did not feel too hot. The covering over the terrace and balcony facing south, together with the vent through the high-level roof windows on the first floor, apparently work as intended. Then the weather changed on 4-5 of July: cloudy and windy with showers. The living room is perceived as a cool room, but we blame it on the fact that the floor heating has not kept pace with the change in the weather. Since then, it has remained cool in the house, especially in the living room. We have noticed that windows are open even though we feel cold. There is a draft so we wrap ourselves in blankets and close the windows with the remote control….. but alas, half an hour later they open automatically again! Haha, yes we are really aware of the deceitful Danish summer!)
It surprised us a little that we perceive the house as being cold; the temperature set-point is several degrees higher than the 21 degrees or so we had in our previous home. It may be due to the movement in the air, partly from the frequently open windows, partly from the Nilan ventilation system. Also noted a slight draft from the ventilation ducts in the living room and kitchen where the ceiling height is not so high, and the airflow from the ventilation ducts felt more direct.
We agreed to give it some time to experience the indoor climate with the change in weather, but at the end of July we contacted WindowMaster anyway to change the control parameters. They were set by the limits within which the windows should be open, how much and for how long. It made an immediate improvement but it is too early to say whether this is the final answer - because in the meantime it is nice weather again.
We will certainly return with news about the indoor climate! (...)

Lights
There is a wonderful light and view in Home for Life! You can clearly see that the window area is much larger than in an ordinary detached house. From the family room we have a view to the east, south and west through large panorama windows. (...) In this room, where we spend most of our time, we have been able to follow the clouds wandering across the sky. It is especially beautiful when the weather changes. The sun over Århus Bay while dark gray skies come in from the west followed by rain, thunder and lightning ... and then again clearing up from the west. Really beautiful!
There are also a couple of disadvantages to these panoramic windows. The sunlight can be so strong that you have to squint. It was Anna, aged 6, who first noticed that and said that she had a headache from all the light. It taught us to lower the awnings and roll down the large wooden vertical blinds a bit when the light is strongest. Problem solved!
The other problem is that although the large windows give us a fantastic view, passers-by get a good view of us inside. Especially in the evenings when there is light inside and it is dark outside, the family room and living room work as magnets for a look inside. And in the evening the exterior awnings in the family room are useless. With such a large lighted 'display window' it is understandable that those who walk or drive by automatically want to see in. It is obvious that we need some curtains.

September 30, 2009

It is autumn and after three months in Home for Life, everyday life is becoming more routine. At least one form of everyday life, because there is always something happening. Technicians, journalists, film crews, architects, municipality people and a few VIPs have passed through our home in a steady stream since we moved in. (...)
And then there is Morten and Johanne, our 'house photographer' and 'house-anthropologist'. They are both able to enter into our daily lives without disruption. It is amazing how they can get our children to behave in front of the camera, beaming with smiles and happiness, in picture after picture. These are the same children who usually hide or stick their tongues out when we parents try to take a good picture of them.
But where does an anthropologist come into the picture?
Well, Johanne works for the Alexandra Institute in a parallel project called Minimum Configuration Home Automation, where Home for Life, and we as testers, are only one part of a larger study. It's about how user-driven innovation works, how users acquire new technology and how applied technology can help save energy for tomorrow's homes ... we think!)
Johanne followed us in our old house for a few months before we moved into Home for Life. We recorded the energy and water use daily for a couple of months to enable a comparison with our new 'green-tech lives'. Have to admit, it's a little funny to be watched and studied this way - even by a professional anthropologist. It would be nice to know what thoughts she has and what personal details are now being noted down about our family, our ordinary lives and the way we bring up our children...
On the other hand, there are also many good questions and 'exercises', which makes us wonder a little about why we actually do things as we do and what good industrial design and graphic expressions mean, whether we accept and use new technology; such as when we had to draw a map of our movements in the house on a weekday and a weekend day. The exercise showed we were really quite content to stay in about 40 m² of the house – that's where most of our time is apparently spent.
(...) Now we have finally found out what most of the buttons are for but a light still switches itself off at undesirable times. The other evening I was sitting at my computer in the family room, concentrating hard. Every now and then I rocked back and forth on the chair just once to make sure the light did not go out. It gives a whole new meaning to "active house", but it must look a bit strange from the outside...
Meanwhile, the interior curtains and exterior solar protection are also automated. The system is partly controlled by a timer (curtains down at night) and partly driven by energy optimisation - the solar protection goes down if the sun warms up the family room too quickly, while the

inner curtains automatically go down at night to keep heat indoors, but only if it is cold outside. It's smart! ... And it was a great surprise the first few times when they are all running at the same time!
Laundry is still dried in the annex. Now that it is autumn, we can see drying takes longer. But it still works and we can just manage.
Autumn also means the beginning of the heating season and the heat pump has now come into use. We have not noticed it much in the last few months as the collector has taken care of all our heating needs. When the hot water for room heating and hot household water gets too cold, we hear the heat pump start and heat it up again. And this will happen more and more, because we clearly notice that the sun has lost power. Electricity production from solar cells varies greatly from day to day and from week to week. We still have a comfortable surplus in September, thanks to a sunny late summer, but consumption has also risen markedly. Some of the increased power consumption comes from the heat pump of course but we were a little surprised that the increase was so noticeable. So the other day some plumbing people dropped in. Their visits may mean lower power consumption, but we now also have full power on the heat in the bedrooms.
Late September weather forecast from Lystrup: tropical nights with up to 27 degrees. Phew!
Probably not reducing energy consumption. Well, the heating system will soon be checked again."



December 21, 2009

The Climate Conference COP15 is finished, Obama and the other world leaders have gone home. The mood of the media has swung between optimism and disappointment along the way; the political momentum up to the Conference was greater than at any other time, yet it ended with an unaccomplished mission.
Before his departure, USA's President Obama held a press conference for the American press, where he referred to the climate challenge not only as a threat to our planet but also as a great growth opportunity for American industry. At the same time he acknowledged that the USA had been lacking in leadership in this area in recent years. Here in Europe we turn to the forefront of development, with the Active House concept and Home for Life as good examples. A number of known technologies and new products are being tested in conjunction with CO2-minimised building materials and automation of the home indoor environment.
The goal is clear: a dwelling in which architecture, comfort and sustainability go hand in hand. Energy accounts are expected to end with a sizable surplus, so that house can not only be called an Active House in itself - but after a few years, the energy stored in its materials will also have been paid back.

Rescued by the sun

But as with most newly constructed homes, Home for Life has a long way to go from vision to reality. We have been told that the energy consumption during the last couple of months is higher than expected. The house has been examined for leaks (and sealed in a number of places), heater inlet temperature has been adjusted and we are currently in a trial period where natural ventilation has been switched off (the windows do not open automatically) and replaced by the air through the ventilation system (with heat recovery). This must surely save some energy, with the cold outside air not being warmed up by floor heating but pre-heated by the out-going air. But it can be felt in the indoor environment. CO2 levels are generally higher and temperatures in the rooms vary much more depending on whether the sun shines. We have had temperatures of up to 25ºC in the living room on sunny days. But unfortunately it also works the other way round. The temperature on the ground floor of the house is usually a degree or two under the set point and in recent weeks especially we have not really been able to keep warm.
It was fine that fitters and an engineer came on Friday to do something about the settings and repair the ventilation system, which proved to be all over the place. But so far it has not helped. It is believed now that there must be a fault in some of the floor heating valves or perhaps some of the underground pipes are blocked – a problem that can arise in any building. And it fits in very well with our feeling that the floor on one side of the kitchen-family room is warm, while the south side is very cold – an observation that has now been confirmed with the arrival of winter.

Children for life

Since the last report, a new reinforcement has been added to the test family. On 30 November, a healthy, bouncing baby girl with long black hair came into the world. So now there are sleepless nights, breastfeeding and a lot of laundry for the test family. It feels like we are being sent home in Ludo and the two older children suddenly feel much bigger and live independently! But it is also nice to stand with a brand new person in your arms and to meet its few and simple needs: food, sleep and love.
Speaking of laundry, it is also now clear that the concept of drying clothes in the semi-closed atrium does not really work. It is climate-friendly enough but with the weather here, it is simply a war before the clothes are even barely dry. So the routine is that the clothes are pre-dried in the atrium for about two days before they come inside to hang.
We can record the fact that the good, old-fashioned method of hanging clothes out to dry does not work well enough - they must also be right outside where the wind can reach them. And that means we're going to have a really, really good time in winter! But we soon surrendered and acquired a dryer (A-rated of course).
But in the midst of all the moving around of laundry, we now come to consider some things: how privileged we are! Three fit and healthy children, born in one of the most

affluent societies where they can get the best conditions in life.
It is for them and succeeding generations that the climate challenges are indeed very present. Maybe this is scary - if it goes as badly as the most pessimistic scientists predict.
It is naive to think that developments can be stopped and that we can spare ourselves from global warming. The developing countries have a full head of steam and their legitimate aspirations for increased wealth and prosperity cannot and must not be blocked. I choose to believe instead that research and development will find solutions to tomorrow's climate problems. Part of the solution may already have been found in Home for Life. A good first step - but you have to start somewhere. And I wonder if Obama is right.
If we in the industrialised countries make use of our business acumen, there is a huge potential for knowledge-based community growth and export of know-how.

Happy New Year and continued good climate debate in 2010!
21 December 2009
Sophie & Sverre Simonsen
+ Axel, Anna and "little sister"
Test family in Home for Life

BETWEEN FJORD AND FELL
PREIKESTOLEN FJELLSTUE
STAVANGER

"To achieve the best possible interior climate, it has been our intention to use as 'pure' materials as possible that do not emit noxious chemicals. This was possible by means of a thorough examination of the Environmental Product Declaration of the building materials."

Dag Strass, Arkitektfirma Helen & Hard

The Preikestolen (literally Pulpit Rock) overlooking the Lysefjord near Stavanger certainly does justice to its name. At the top, the rock plateau is practically flat, forming a natural viewing platform whose front edge drops sharply to the fjord some 600 metres below.

At around half height between the fjord and Pulpit Rock, architects Helen & Hard have constructed a new 28-room hotel, restaurant-café and conference venue to replace the nearby former mountain lodge. The new mountain lodge reflects the rain-drenched climate of the region. Almost the entire building envelope is formed by roof surfaces that extend downwards and over the sides of the building. The view afforded by the many windows in the facade and the roof takes in the mountain panorama on one side and the nearby lake, the Refsvatnet, on the other.

Guiding principles for the design included the greatest possible energy efficiency and a healthy indoor climate, with preference given to the use of pure, biologically harmless construction materials. The architects took this principle much further than is customary by carrying out precise checks of the environmental product declarations provided for the construction materials used.

The Preikestolen Fjellstue is a textbook example of unadulterated timber construction using pure materials. Its supporting structure comprises laminated beam elements whose individual laminations are interconnected exclusively by wooden dowels. The timber surfaces have also been left largely untreated. The floors are covered in slate and solid wood. The wet rooms have been finished with untreated concrete floors. The architects had the fireplace on the ground floor coated in lime plaster mixed with horse manure.
To achieve the targeted high degree of energy efficiency even in winter, the Preikestolen Fjellstue has been fitted with a mechanical ventilation system featuring rotating heat recovery and plate heat exchangers. The underfloor heating on the ground floor is fed by a heat pump using the water from the nearby lake as a heat source.

But fans, heat exchangers and piping systems are not the only source of ventilation in the lodge. The client was particularly concerned that the roof windows in the building envelope should be capable of opening, so providing a natural source of fresh air to guests. Individual electric radiators in the rooms have been dispensed with to prevent guests opening windows and turning up the heating. The stove-side bench on the ground floor is a popular rendezvous for guests after a long and tiring day hiking on the Fell. This works along the lines of a hypocaust heating system that draws hot air from the wood-burning stove through the communal room and guides it back into the stove.

Previous spread Unobtrusively and without fuss, the roof silhouette of the mountain lodge blends into the fjord landscape of south Norway. Behind the building is Lake Refsvatnet, beyond which the terrain leading down to the Lysefjord descends steeply by a height of 300 metres.

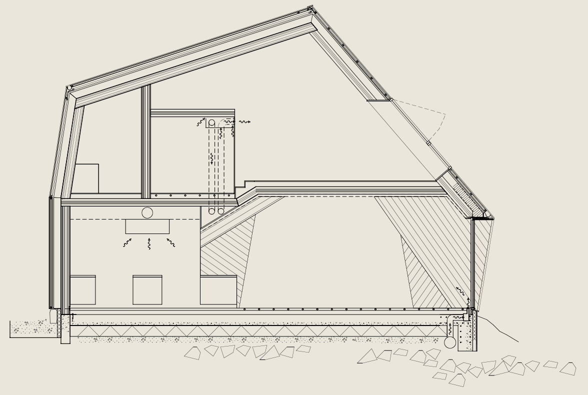
Opposite page The striking shape of the building's roof also impacts on the character of the interior. Roof windows bring daylight and fresh air into the guest rooms, where the floors, walls and ceilings are all made of solid wood.

Right Cross section

Below View into the dining room on the ground floor. Here as well, the wooden supporting structure determines the impression made by the room. Dowelled timber boards span the 6-metre-wide room, without there being any supporting columns.

Facts

Building type:	Lodge with 28 rooms and restaurant-café
Client:	Stavanger Turistforening, Stavanger, N
Architects:	Arkitektfirma Helen & Hard AS, Stavanger, N
Location:	Lysefjord near Stavanger, N
Completion:	2008



LIGHTHOUSE PROJECT FOR ENERGY AND INTERIOR CLIMATE

GREEN LIGHTHOUSE IN COPENHAGEN

"Green Lighthouse, Denmark's first CO_2-neutral public building, demonstrates that sustainable design starts with good old-fashioned common sense. Many 'green' design features were incorporated into the building to reduce energy use and provide a healthy indoor environment for students and faculty. The building itself was oriented to maximise its solar resources, while windows and doors are recessed and covered with automatic solar shades to minimise direct solar heat gain inside the building."

Michael Christensen, Christensen & Co. Arkitekter

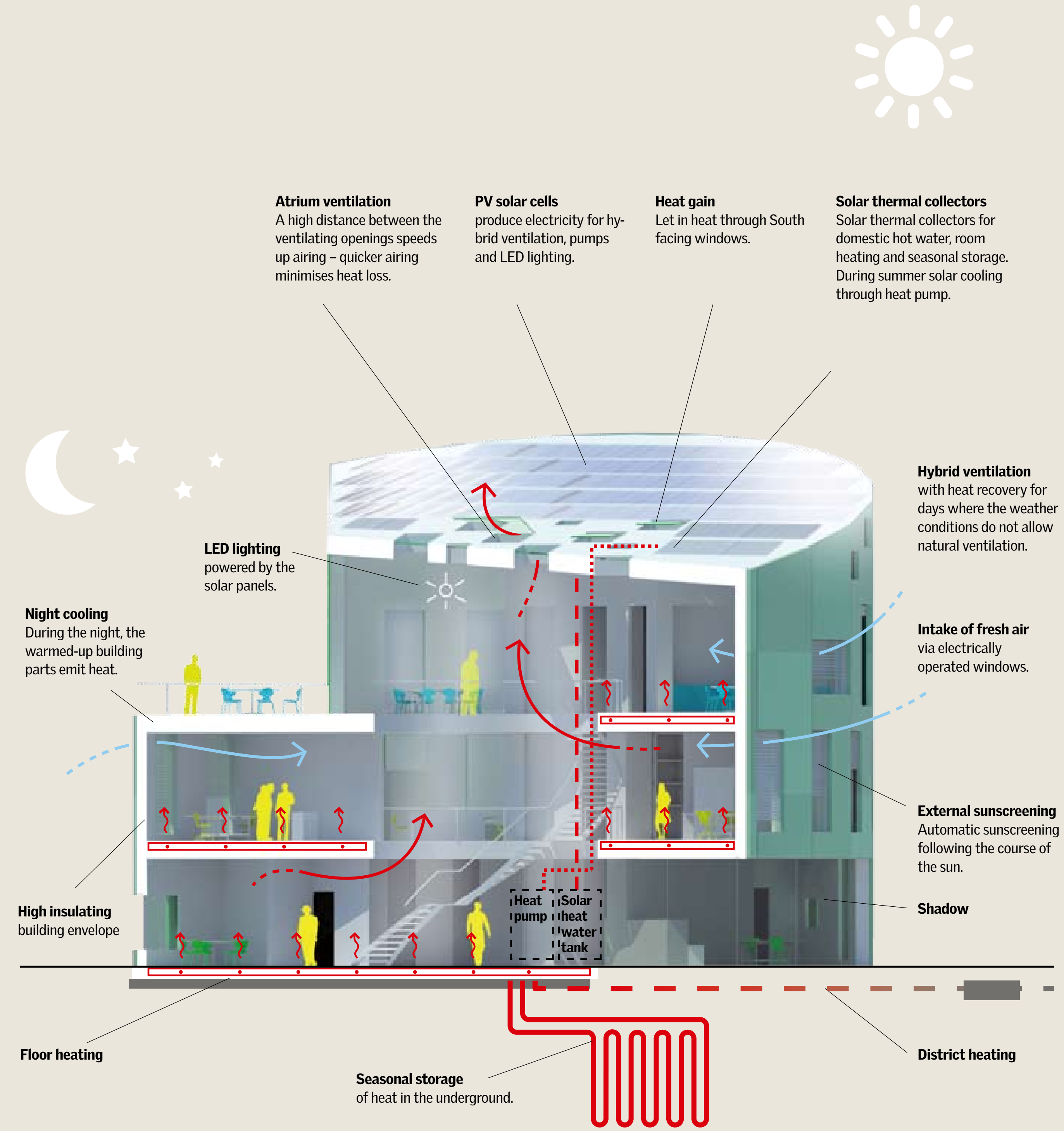
The Green Lighthouse, a new facility for the Faculty of Science at the University of Copenhagen, is one of a number of pilot and demonstration projects built in the Danish capital in advance of the UN Climate Summit. It was constructed in strategic partnership between the University, the Danish University and Property Agency, the City of Copenhagen and the companies VELFAC and VELUX, and provides a 'one-stop shop' service centre for the students, and facilities for the Dean and professors of the science faculty. The objective was for the office building to be carbon-neutral, meeting the future demands of energy consumption in 2020 without compromising maximum indoor comfort and well-being of the users.

From an architectural point of view the house was inspired by the sundial and the movement of the sun around the house. The design underlines the fact that the sun is an important topic in science and one of the most significant energy sources in Green Lighthouse.

During the planning phase, a series of interdisciplinary workshops were held with the aim of combining energy efficiency, use of renewable energy sources and creation of an optimum indoor climate. But Green Lighthouse was also designed to be carbon neutral. Achievement of this goal hinged on various design strategies – the compact building geometry, site orientation, a dynamic and efficient building envelope comprising thermal insulation and sun shading, the maximisation of passive solar gain, the passive accumulation of heat and cooling in construction, hybrid ventilation, the use of daylight, and LED base lighting with daylight control.

Natural ventilation is achieved through facade windows in combination with the roof windows in the sloping roof surface. The building is organised around an inner, light atrium forming the social heart of the house and uniting staff and visitors under a soothing roof light. This room is also necessary to ensure that the natural ventilation of the house works: fresh air is taken in at the facade, sucked through this room and exhausted through the roof windows at the top.

This also provides night cooling for the office rooms during summer. All windows and shading devices are automatically opened and closed as a basic prerequisite to achieving the strict energy specification at the same time as creating a pleasant working environment. Daylight is one of the most essential requirements for a high degree of user comfort in the building. The required daylight factor was 3% in permanent work spaces – but levels are generally higher than this in the upper floors. The daylight balance is achieved through the 18 roof windows flooding the central atrium with daylight. For Michael Christensen, owner of architectural office Christensen & Co., the daylight concept was the determining factor in the arrangement of the window openings. "In terms of insulation, wall and roof are equal. But a window in the roof can provide substantially more light than a window in a wall."



Opposite page **Draft sketch of the 'Green Lighthouse'. The arrows indicate the building envelope's functions, which are also important for the indoor climate: air flows into the building through the windows in the facade, becomes warmer in the atrium and then exits again through the roof windows. An exterior sunshade system prevents the rooms from overheating.**

Below **Cross-section with energy concept of the building**

Facts

Building type:	Office building
Strategic Partners:	Copenhagen University, Ministry of Science, City of Copenhagen, VELUX & VELFAC
Client:	The Danish University and Property Agency, Copenhagen, DK
Architects:	Christensen & CO., Copenhagen, DK
Energy concept:	COWI, Copenhagen, DK
Location:	16 Tagensvej, Copenhagen, DK
Completion:	2009

Top left **The atrium is the communicative heart of the 'Green Lighthouse'. Moreover, it makes a major contribution to air circulation in the building. The chimney effect created here makes the warm air rise so that it can finally escape through the roof windows.**

Bottom left **'Green Lighthouse' at twilight. The circular ground plan with windows on all sides makes it possible to follow the path of the sun around the building from the inside as well. The compact volume of the structure also helps to avoid heat losses.**

Below **The upper floor features large window areas, opening up the view to the surrounding green areas and the sky. The daylight factor in this area is around 9 per cent.**

WHAT YOU SEE IS WHAT YOU GET
OFFICE BUILDING IN AMSTERDAM

Opposite page **The office building was designed according to the principles of the 'cradle-to-cradle' philosophy. Bare wooden elements facilitate re-use if the building is torn down at some time. Additionally, the absence of any wall coverings is also intended to improve the quality of the indoor air.**

Top left **All the work rooms are along the south and west facades and feature building-high windows to let in the light. On the upper floor, roof windows with coloured soffits also allow daylight into the zones further inside.**

Bottom left **Cross section**

Right **A central access area runs through the entire building. On the left of it are the offices, with backrooms and meeting areas to the right.**

"By applying the art of 'less is more' a healthy, inspiring work environment can be created that leaves space to breathe. That provides the calm which is the prerequisite of performance, and that stimulates human creativity. Knowing that, user and building together form a small sustainable world in itself that could otherwise not have been realised. Here, however, it has become everyday reality."

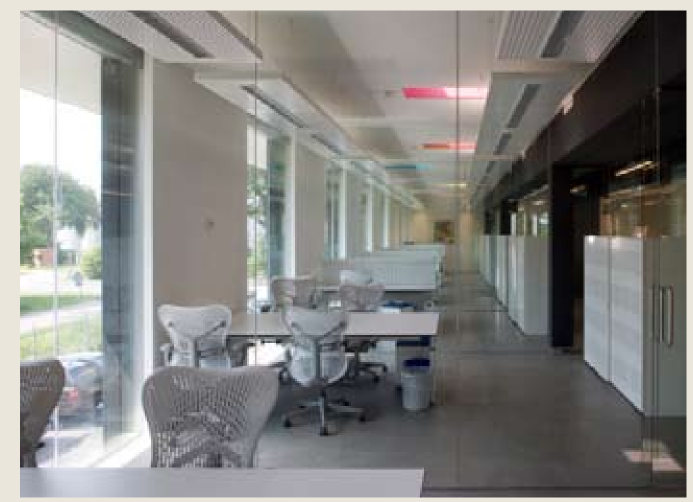
Search Ingenieursbureau

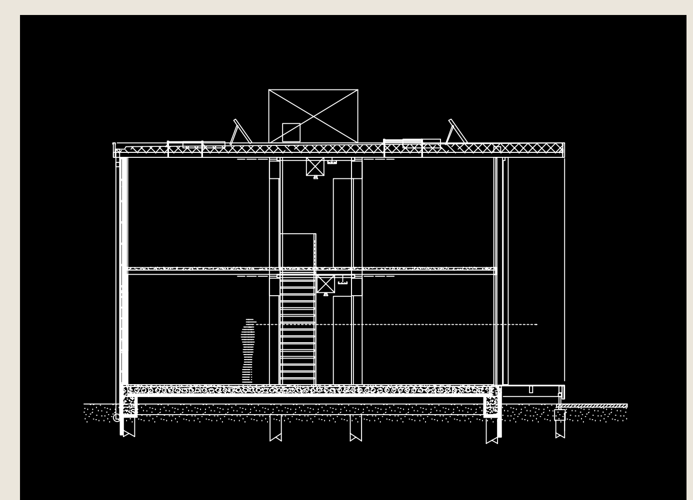
Facts

Building type:	Office building
Client, energy and sustainability concept:	Search Engineering Consultancy, Amsterdam, NL
Architects:	Witteveen Architecten, Amsterdam, NL
Location:	Petroleumhavenweg 8, Amsterdam, NL
Completion:	2008

The new building that architect George Witteveen constructed for engineering consultants Search stands in Petroleumhaven in Amsterdam, an uninviting district to the west of the city centre not far from the banks of the river Ij. Witteveen placed a deliberately austere building volume against the heterogeneous surroundings. The look of the building has been influenced not only by the endeavour to achieve the optimum possible use of daylight, but also by the 'cradle to cradle' concept, which strives to make buildings 100% recyclable and – by avoiding the use of harmful substances – healthy to live in. The facade, completely glazed to the west and semi-glazed to the south, is protected in both directions by an overhanging roof. All the workplaces in the two-storey building are also oriented south and west. Behind the largely closed north facade are the conference rooms, the library, the archive, workshops and ancillary rooms, all of which are only used for part of the time. Storey-height glazed sliding walls on both floors allow daylight to fall deep into the building. On the top floor, roof windows provide natural illumination for areas of the building that are more distant from the south facade. The multicoloured reveals of the windows provide relief from the otherwise monochrome black, white and grey decor of the office rooms, lending a cheerful note and deflecting the often dull weather conditions outside.

Solar panels, the use of geothermal energy and two vertical wind turbines installed on the site make the building self-sufficient in terms of energy. Its design is consistently in keeping with the 'cradle to cradle' philosophy. To ensure that as many of the components as possible can be reused after future demolition of the building, and to avoid any off-gassing of harmful substances, the architects reduced the number of layers per component to the absolute minimum. The result is a building that follows the principle of 'what you see is what you get'. The walls and intermediate ceiling are made of prefabricated cross-laminated softwood elements up to 2.80 × 12 metres in size. The outside walls are insulated using a recycled paper-based insulating material. Concrete was only needed for the foundations, the floor slab on the ground floor and the floor structure for the upper storey. Floor coverings and suspended ceilings are nowhere to be found in the new building, nor are rendered or screeded surfaces. The supporting timber construction has been treated using only natural colour coatings.





BOOKS

REVIEWS
For further reading: recent books presented by D&A.

THE INDOOR ENVIRONMENT HANDBOOK

Author: Philomena M. Bluyssen
Earthscan
ISBN 978-1-84407-787-8

"How to make buildings healthy and comfortable" is the subtitle of this book, in which Philomena Bluyssen, a Dutch expert on indoor climate issues, provides a comprehensive overview of all those factors that are responsible for the climate inside buildings. However, her book goes far beyond an examination of thermal comfort, air quality, lighting and noise; it illustrates the way the various factors interact with each other and how they affect the human body, while pointing out way in which the quality of the indoor environment can be anchored as a goal in planning processes. The book has a wide scope. Bluyssen begins with the way human perception works and explains the most important parameters and formulas for calculating the indoor climate. She goes on to portray the historical development of research and legislation in matters relating to indoor climate and, on this basis, then dedicates herself to the book's central questions: How do the individual factors of light, air and noise complement each other to form a whole, how is this perceived by human beings and how can it be optimised in existing buildings? Setting and adhering to limits for temperature, fresh air supply, air pollutants and daylight is not enough, in her opinion, as their interactions are too complex and the sensitivity of human beings to different environmental factors varies too much from individual to individual. Bluyssen therefore takes a close look at a second approach to research and regulation that starts with human beings and their reactions to the indoor environment. Here, it becomes apparent how difficult it is to pinpoint the concrete causes of human well-being and discomfort (who can exactly say whether fatigue at work is due to a lack of fresh air or the act of working without motivation?) and how irrational it would be to want to establish mono-causal connections between psychological or physical symptoms and individual factors of the indoor environment.

In the last part of the book, Philomena Bluyssen looks at the practical implications of the issue for building design and management. She analyses internal and external influences on the quality of the indoor environment, describes the different roles of the parties involved in planning and construction, and documents the status of international standardisation. Occasionally, the author digresses from the main topic, such as when she covers several pages with statistics on demographic change without indicating their implications for the indoor environment. However, these digressions are an exception: The Indoor Environment Handbook is a first-class standard work that presents current knowledge on the topic in a clear, comprehensible and usefully structured form. Nevertheless, it should be noted that the book is intended as a standard work and textbook for all those who are fundamentally interested in the indoor environment as such. It does not contain concrete planning suggestions regarding ventilation systems, window sizes or thermal conditioning for buildings.

LIGHT, AIR AND OPENNESS

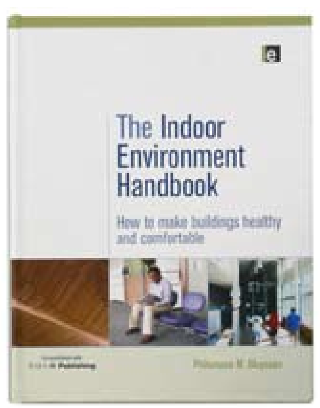
Author: Paul Overy
Thames & Hudson
ISBN 978-0-500-34242-8

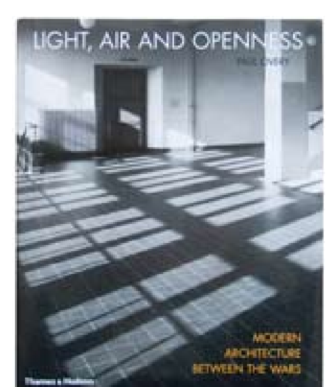
Most books on modernist architecture share something in common: almost all of them touch on the twin topics of hygiene and health but usually content themselves with giving these topics a brief mention before turning to other more aesthetically-related questions. It was left to Paul Overy, now sadly deceased, to examine the ways modernism was influenced, directly and indirectly, by the quest for light, air and openness in his book of the same name, published in 2007. Overy describes in detail how the concept of hygiene developed in the sanatoriums of the 19th century, how it was seized upon by the "life reform" movement at the beginning of the 20th century and the evolution of the concept up until the Second World War. In his 200-page book, Overy focuses on buildings for healthcare and sports, living and working, continually eliciting new aspects of their design. He examines the ideological roots behind notions of hygiene and the concept of abstaining from all forms of ornament, looks into the role of water and of sanitary engineering in modern architecture and demonstrates how the architects of modernism literally "built their houses in the sun".

Overy proves himself to be an extraordinarily well-read author who enjoys spinning a good yarn, even if he is less interested in giving detailed descriptions of actual buildings. The social discourse of the interwar years appears to be more important to him than the architectural solutions. Consequently the book contains not a single architectural drawing but instead many telling historical photographs showing the buildings and often their occupants.

The author clearly experienced some difficulty in ordering his material. The paths he follows while expounding his topic are convoluted; the sequence of chapters Health, Home, Sun, Water, Factory offers only a rough indication of where the author is in his story. This has the advantage that the reader can pick up Light, Air and Openness and start reading anywhere and the disadvantage that searching for a particular fact is not easy. The attentive reader will also notice some gaps: Overy eloquently presents modernism as a quest for healthier living conditions but he does this without providing any detailed description of the unhygienic conditions in the cities that modernism was attempting to combat. Thus he portrays modern architect primarily as an idealistic endeavour and less as a battle against existing and catastrophic living conditions.

Despite these quibbles, Light, Air and Openness has an incontrovertible quality against which future publications on this topic will always be measured: that of having extensively examined and absorbingly described a concept – hygiene and health – that continues to be important to us today and the influence of this notion on a particular, still formative architectural period.





SENSING SPACE

Authors: Nadin Heinich, Franziska Eidner
Jovis Verlag
ISBN 978-3-939633-95-2

Franziska Eidner and Nadin Heinich begin their book by asking a multitude of questions: "In what way does the conscious integration of new technologies create spaces which move us and, if done well, allow us to feel a bit more 'at home'? [...] What is 'home' in the 21st century? What is meant by such terms as 'interactive rooms' and 'intelligent architecture'?"

To cut a long story short: the answers provided by the book are heterogeneous and many-voiced. Most of them are outside the mainstream discourse, i.e. outside the tendency to view technology integrated in buildings as an invisible means serving a higher purpose, such as improved energy efficiency or greater comfort. The book has come out at an interesting time, when many architects, after their initial euphoria, appear to be turning away from experiments on the use of computer technology in architecture. This field, it would seem, is now increasingly occupied by industrial companies offering standardised solutions. In contrast, Sensing Space shows that numerous architects and artists are still concerned with the question of how sensors, actuators and computer-based data networks can contribute in different – more sensual and poetic – ways to architecture and urban spaces.

The authors present a total of 22 projects and concepts, flanked by numerous comments, background information and short interviews with various project designers. The book is divided into three chapters that respectively examine the role of interactive technology in living spaces, on the exteriors of buildings, and in the city. Criticism is repeatedly voiced against previous implementations of 'intelligent' or 'media-based' architecture: so-called 'smart homes' as propagated by industry, which are primarily designed to stimulate the sale of 'comfort' technologies, and the ubiquitous, self-contained media projections flashing on the walls of buildings as they spread their advertising messages through our cities. Although some of the projects presented here remain sketchy, they demonstrate that different approaches are imaginable: for example, technology that would show emotions – whether that of the inhabitant, of his partner living hundreds of kilometres away, or, in the case of household robots, even its own; or a technology that would make the invisible visible – whether this is wind and weather phenomena, the energy consumption of whole city districts, or pictures from CCTV cameras usually only accessible to a select group of persons.

Sensing Space is a fast-paced and stimulating read, which clearly shows that it "was created out of curiosity" (as the authors commented in the book's introduction). The book does not provide a complete or even a scientific overview of the topic. It resembles an art exhibition, presenting numerous viewpoints side by side, arranged in loose association and linked to one another by the comments of the authors. It charts the fever curve of an architecture scene which is still 'hot' and surprisingly dynamic.

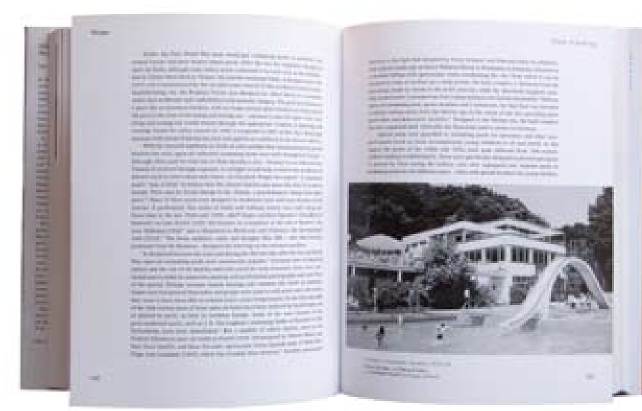
DAYLIGHTING, ARCHITECTURE AND HEALTH

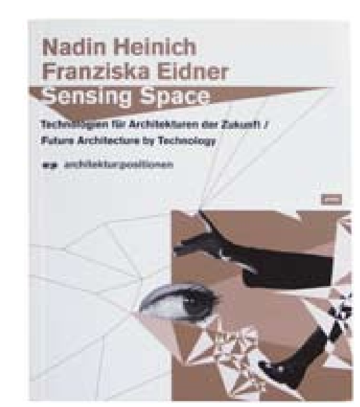
Author: Mohammed Boubekri
Elsevier/Architectural Press
ISBN 978-0-7506-6724-1

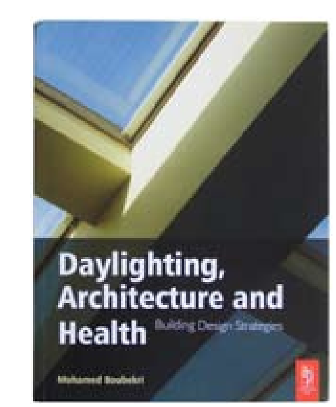
There are many reasons to make good use of daylight in architecture. In his book Daylight, Architecture and Health, Mohammed Boubekri lists some of them: daylight has a positive effect on people's sense of well-being; it increases productivity and contributes to healing in numerous diseases. Boubekri manages to summarise the most important scientific findings based on research into the interrelationships between daylight, the psyche and health in his book and present them compactly and in such a way that they can be generally understood. In addition he provides a brief historical synopsis of architecture's use of daylight together with an overview of various legislative and standardisation policies in various countries with regard to daylight.

The information he provides makes it clear how much we already know about the positive effect of daylight and how few mandatory regulations exist that would compel us actually to make use of daylight. On the one hand, this is certainly due to the fact that latterly health-related aspects of building and daylight planning have been obliged to take a back seat to energy-related considerations. Moreover, the scepticism of many legislative bodies and planners regarding 'undesirable' side-effects of daylight such as overheating and glare also play a role. Boubekri does mention these objections in his book but he does not rebut them.

From a scientific point of view, Daylight, Architecture and Health is a commendable book, as it summarises numerous findings in a single, coherently structured volume for the first time. It should provide an important basis for further research, for discussions between specialists and (hopefully) for future legislation. But the book only partly lives up to its subtitle Building Design Strategies, if at all. When it comes to translating concepts of daylight into concrete ideas for buildings, Boubekri's treatment remain cursory. While he does devote a separate chapter to the presentation of different types of windows and skylights, light channelling and shadowing systems, the book's substance does not go much beyond what is already known to readers from other design textbooks. Architects are still awaiting concrete design guidelines offering detailed and quantitative analyses of existing and planned solutions.







DAYLIGHT & ARCHITECTURE
MAGAZINE BY VELUX
SPRING 2010   ISSUE 13

Publisher
Michael K. Rasmussen

VELUX Editorial team
Per Arnold Andersen
Christine Bjørnager
Lone Feifer
Lotte Kragelund
Torben Thyregod

Editor, Institut für Internationale Architektur-Dokumentation
Jakob Schoof

Translation
Sprachendienst Dr. Herrlinger
Michael Robinson
Sean McLaughlin

Re-write
Tony Wedgwood

Photo editor
Torben Eskerod

Art direction & design
Stockholm Design Lab ®
Per Carlsson
Nina Granath
Björn Kusoffsky
www.stockholmdesignlab.se

Cover
Dan Perjovschi
www.perjovschi.ro

Inside cover
Rachel Whiteread
House project
Photography by John Davies
www.johndavies.uk.com

Website
www.velux.com/da

E-mail
da@velux.com

ISSN 1901-0982

Rachel Whiteread: House

25 October 1993 – 11 January 1994
Grove Road, London E3

In the late nineteenth century, Grove Road was a typical row of terraced houses of the kind built throughout the East End of London. Some of the road was destroyed in the Second World War and by the 1950s the area was covered with temporary housing. As new tower blocks were built the prefabs were removed. By the early 1990s the terrace was no more – the final houses were demolished early 1993. From the interior of the last remaining house, Rachel Whiteread made an extraordinary sculpture. Whiteread's cast of a Victorian terraced house in London's East End was hailed as one of the greatest public sculptures by an English artist in the twentieth century. Completed in autumn of 1993 and demolished in January 1994, House attracted tens of thousands of visitors and generated impassioned debate, in the local streets, the national press and in the House of Commons.

RACHEL WHITEREAD "HOUSE". PHOTO BY © JOHN DAVIES 1993

LIFE AIR CONDITIONED

VELUX®